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United States Patent [19]

Ohshita

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[54] **BED APPARATUS AND METHOD FOR DRIVING A BEDSTEAD**

[75] Inventor: **Shoji Ohshita**, Miyoshi, Japan

[73] Assignee: **France Bed Co., Ltd.**, Tokyo, Japan

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[30] **Foreign Application Priority Data**

Apr. 21, 1992 [JP] Japan 4-101329

[51] **Int. Cl.**[6] **A61H 1/00**

[52] **U.S. Cl.** **601/90**; 5/613; 5/933; 601/26; 601/98

[58] **Field of Search** 601/5, 23, 24, 26, 29, 601/31, 42, 89, 90, 86, 49, 50, 53, 57, 100, 101; 5/613, 600, 933, 934

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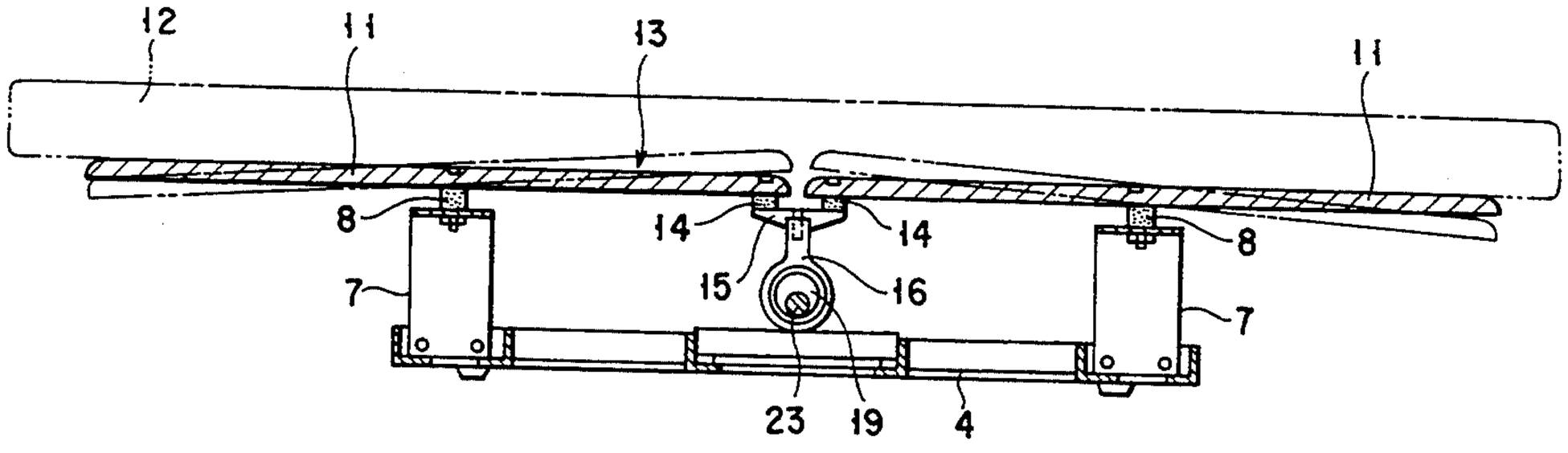
Primary Examiner—Mickey Yu
Assistant Examiner—David J. Kenealy
Attorney, Agent, or Firm—Frishauf, Holtz, Goodman, Langer & Chick

[57] **ABSTRACT**

A bedstead mounted on a bedframe is divided into a plurality of separation pieces. The separation pieces are set swingable on the bedframe. A drive shaft is provided on the bedframe. The drive shaft is rotationally; driven by a driver. The rotational motion of the drive shaft is converted by a power transmitting device to an up and down motion whereby the separation pieces are so driven as to be swingable over the bedframe.

17 Claims, 16 Drawing Sheets



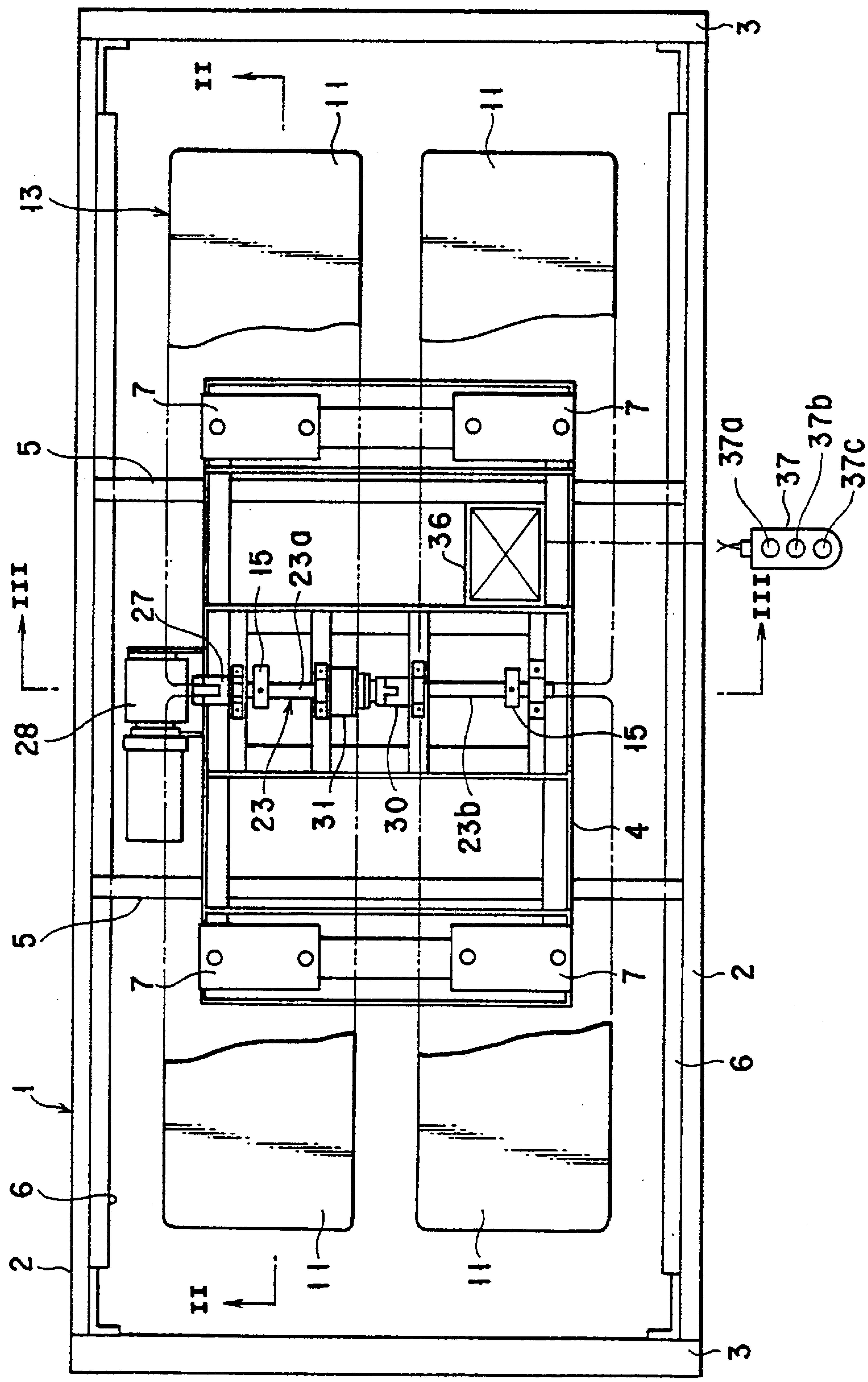


FIG. 1

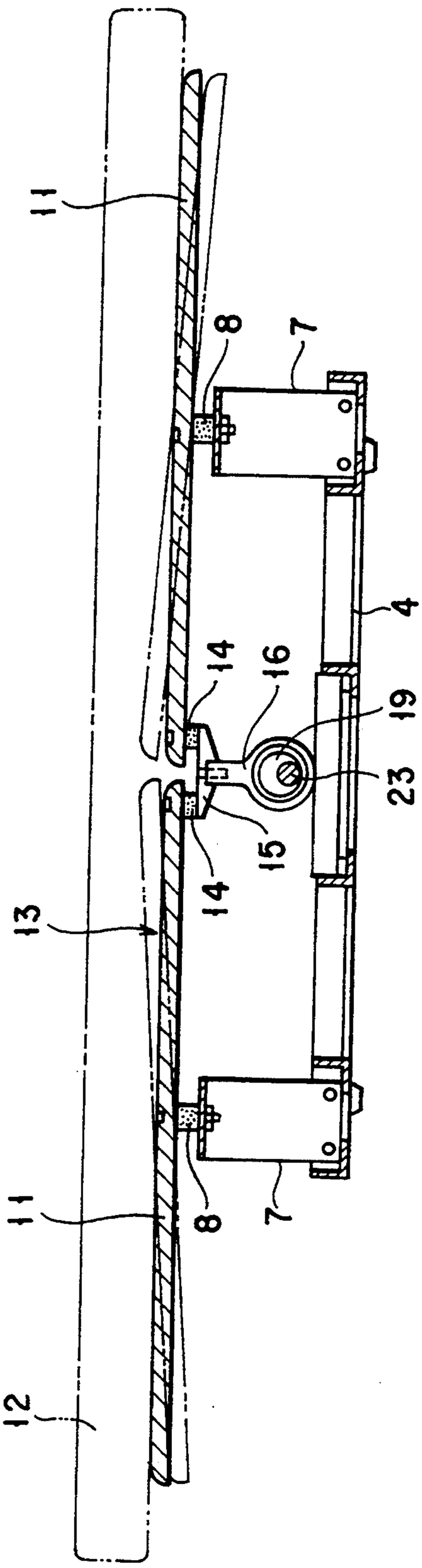
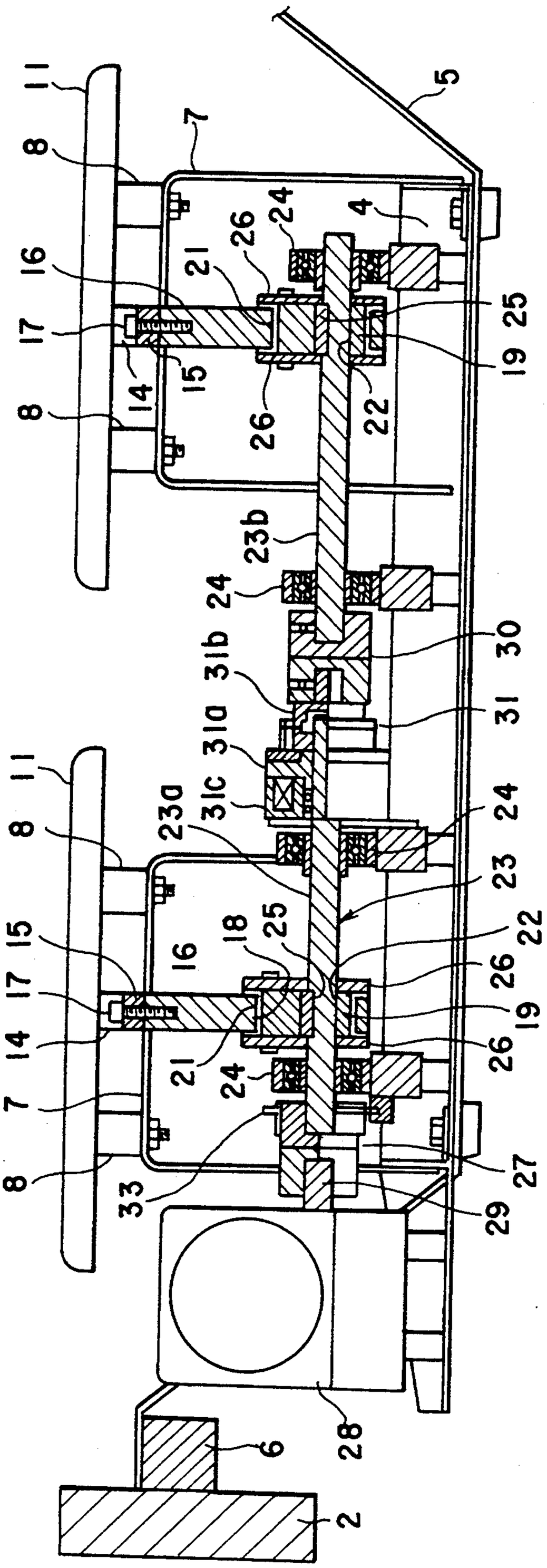


FIG. 2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23b
31b
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FIG. 3

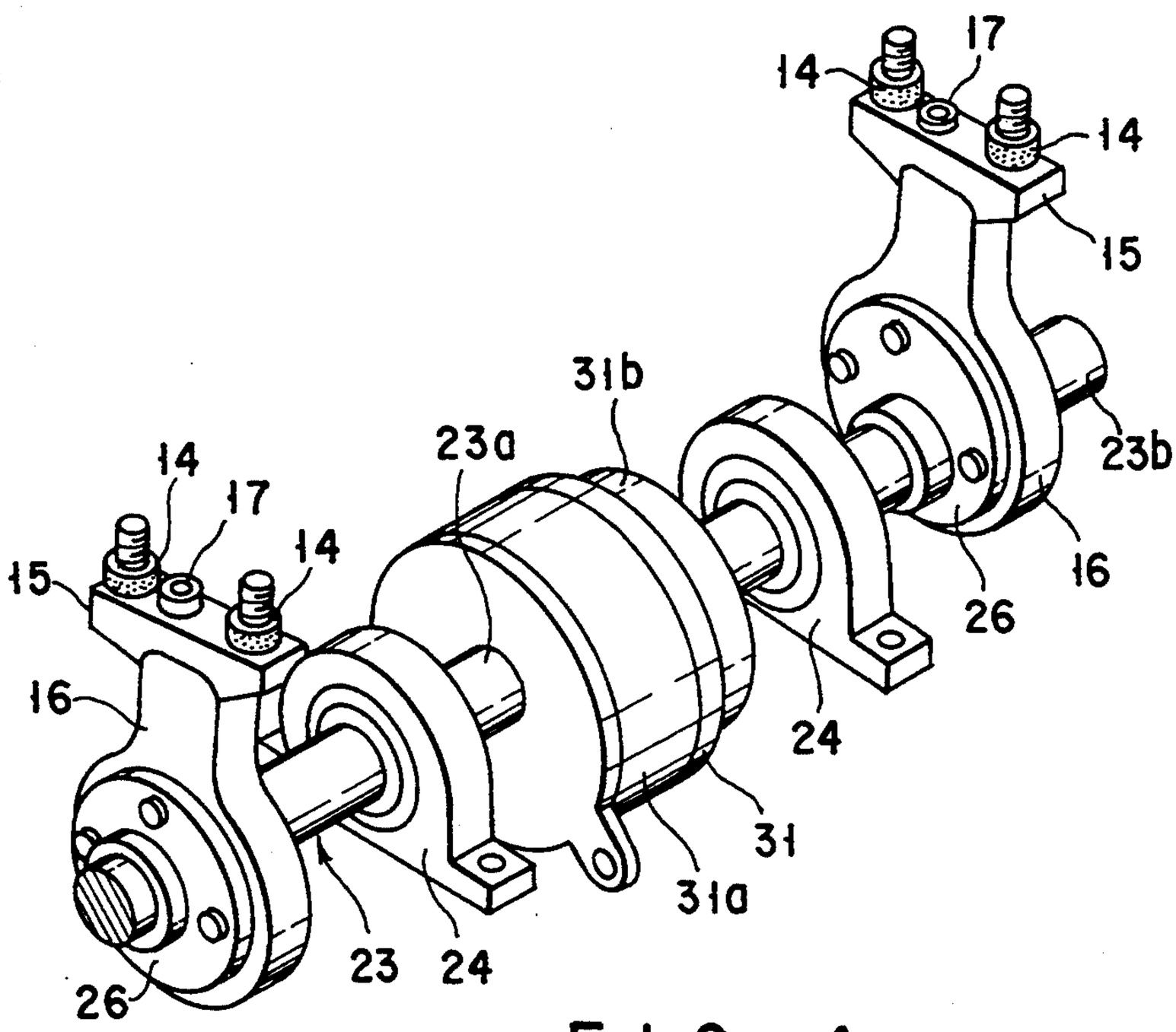


FIG. 4

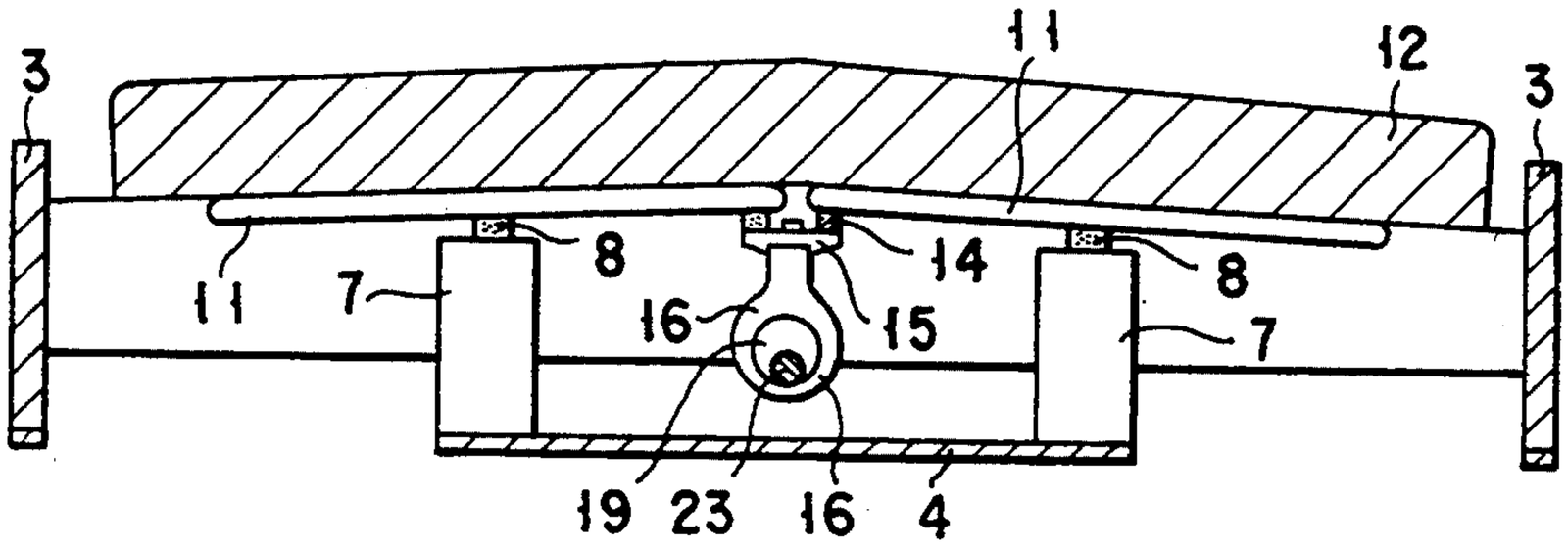


FIG. 5

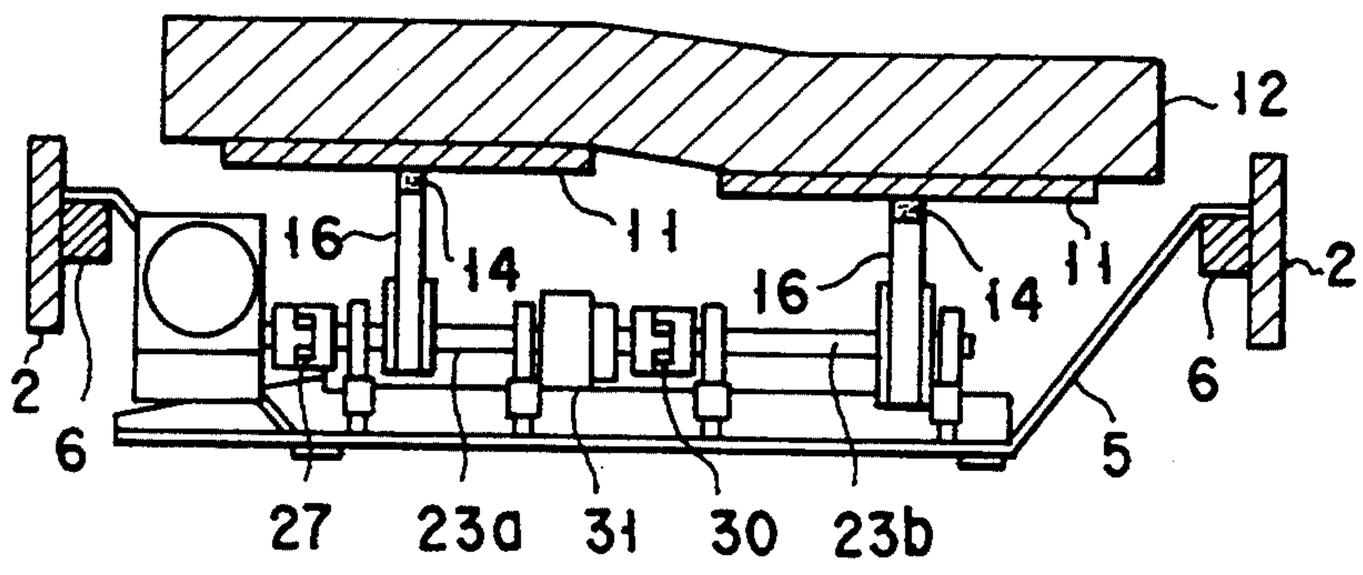


FIG. 6

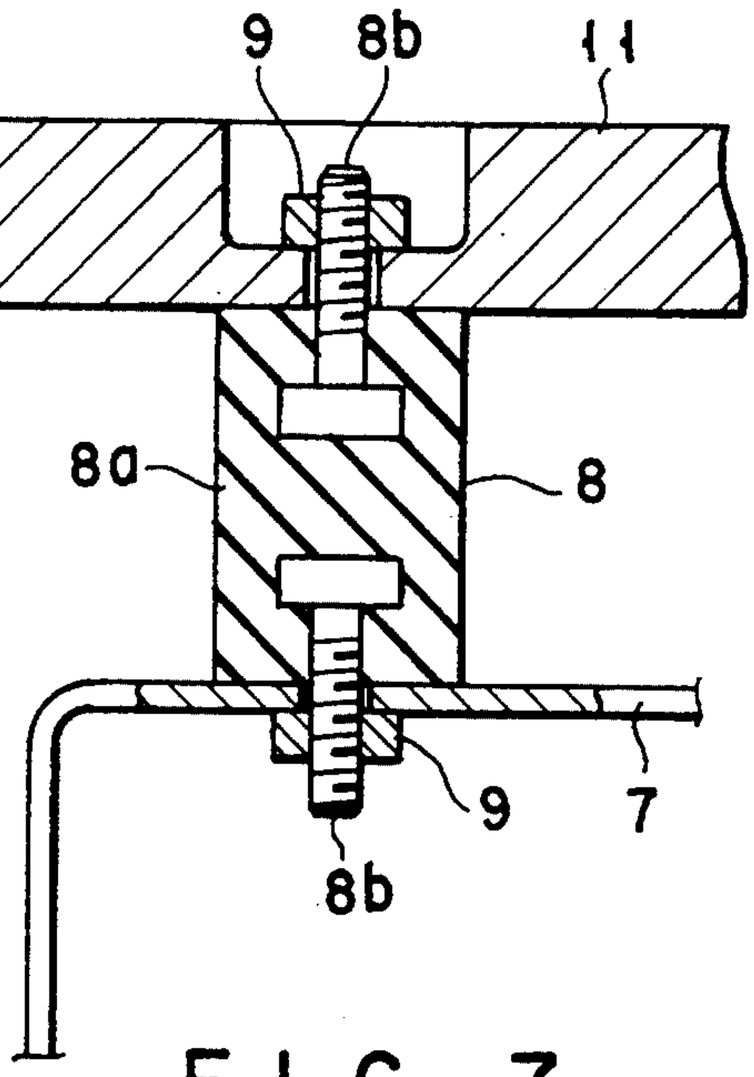


FIG. 7

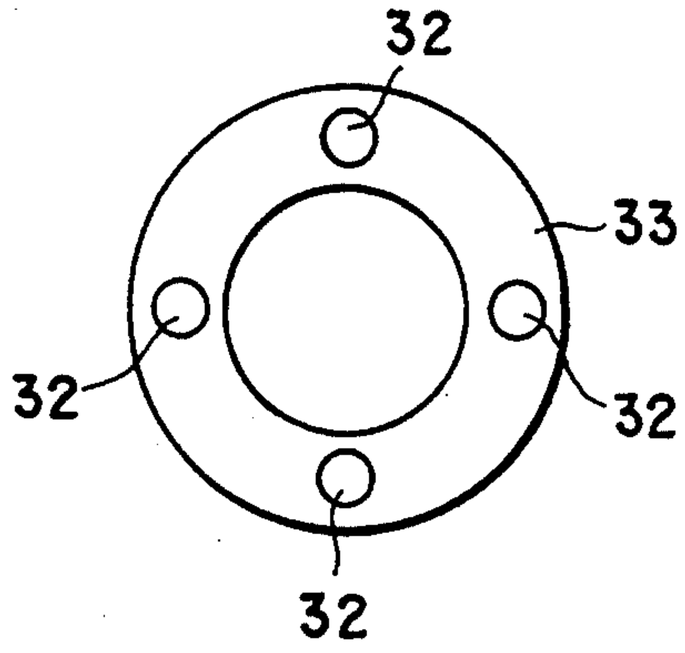
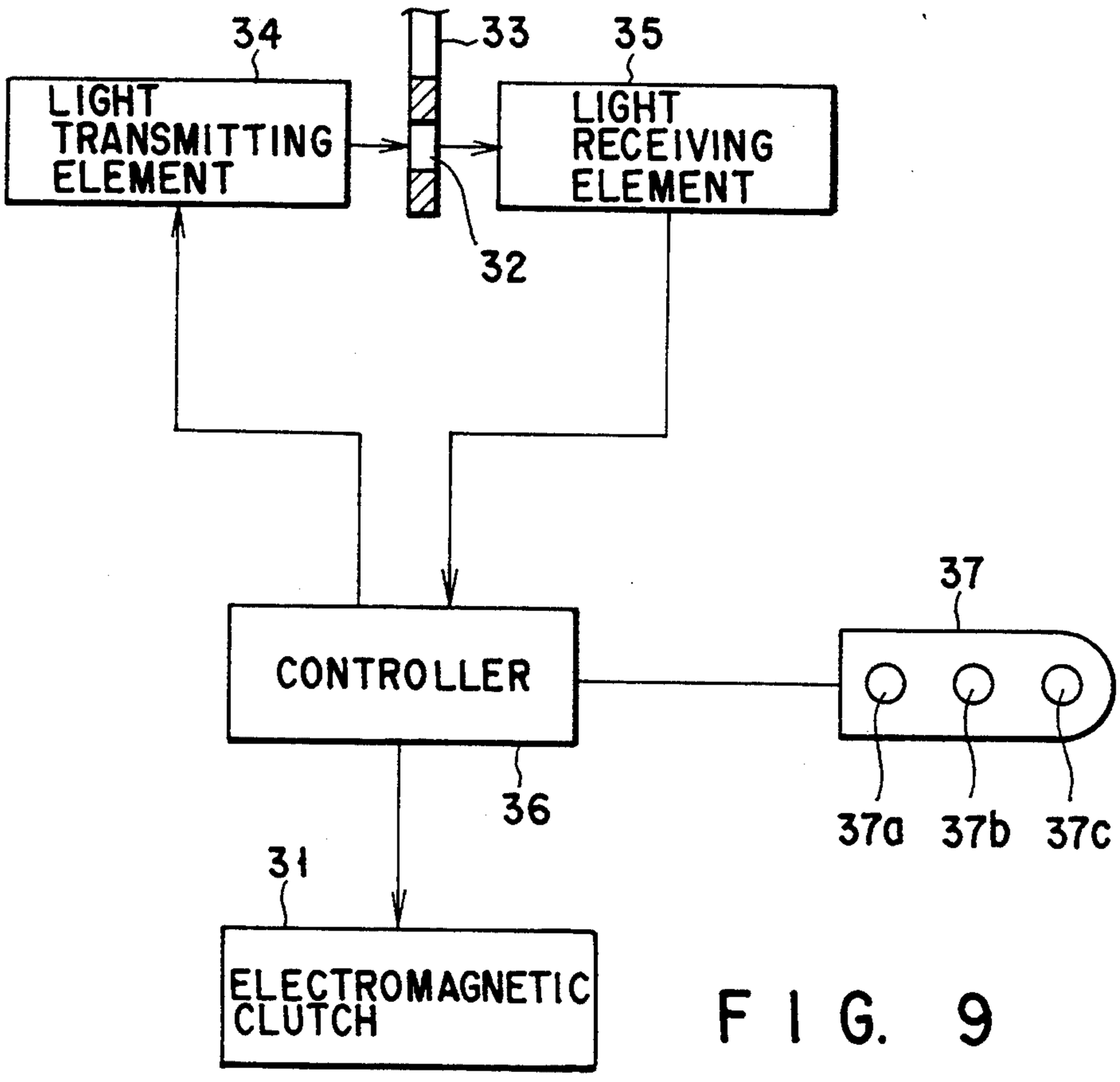


FIG. 8



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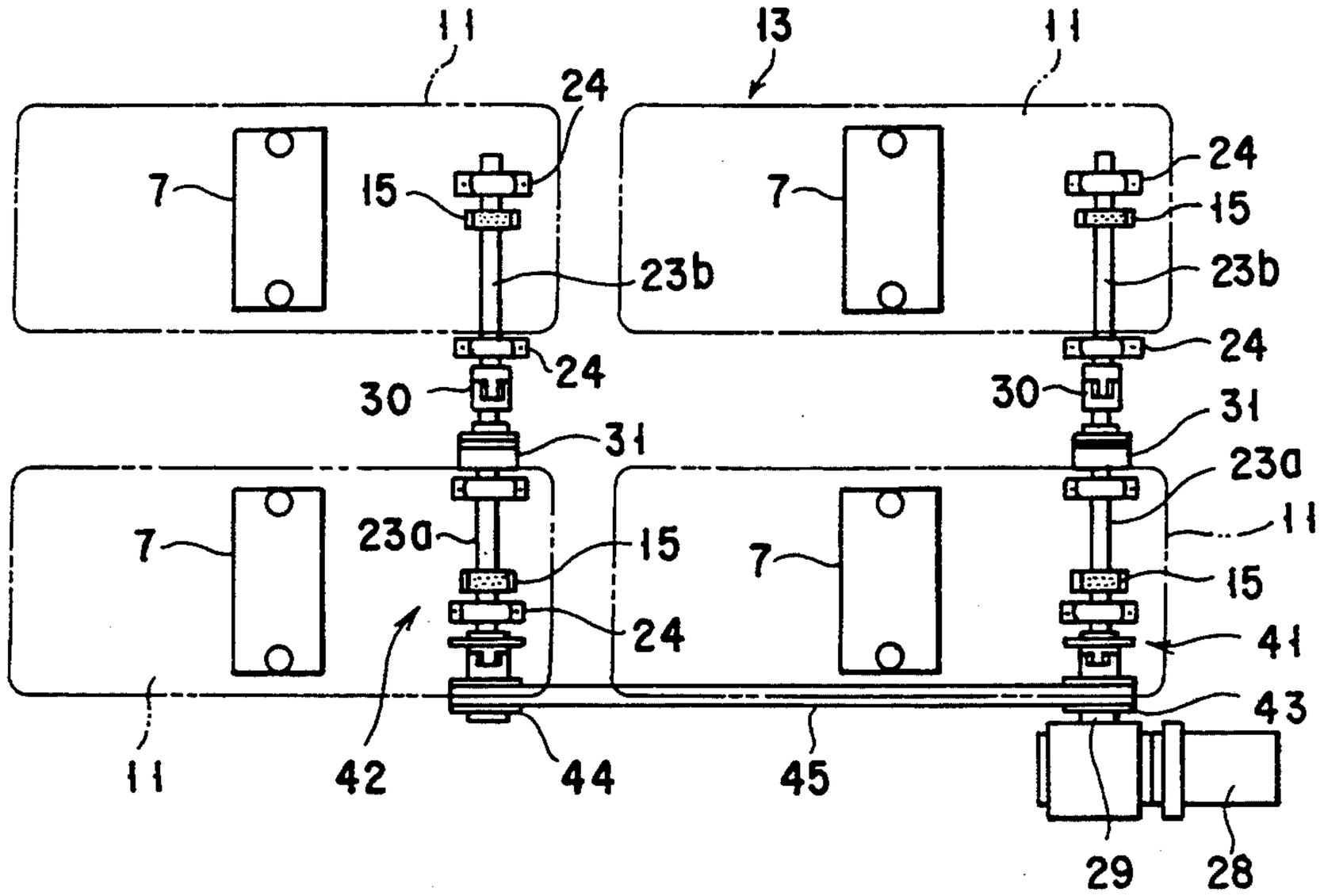
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23b
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23a
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FIG. 10

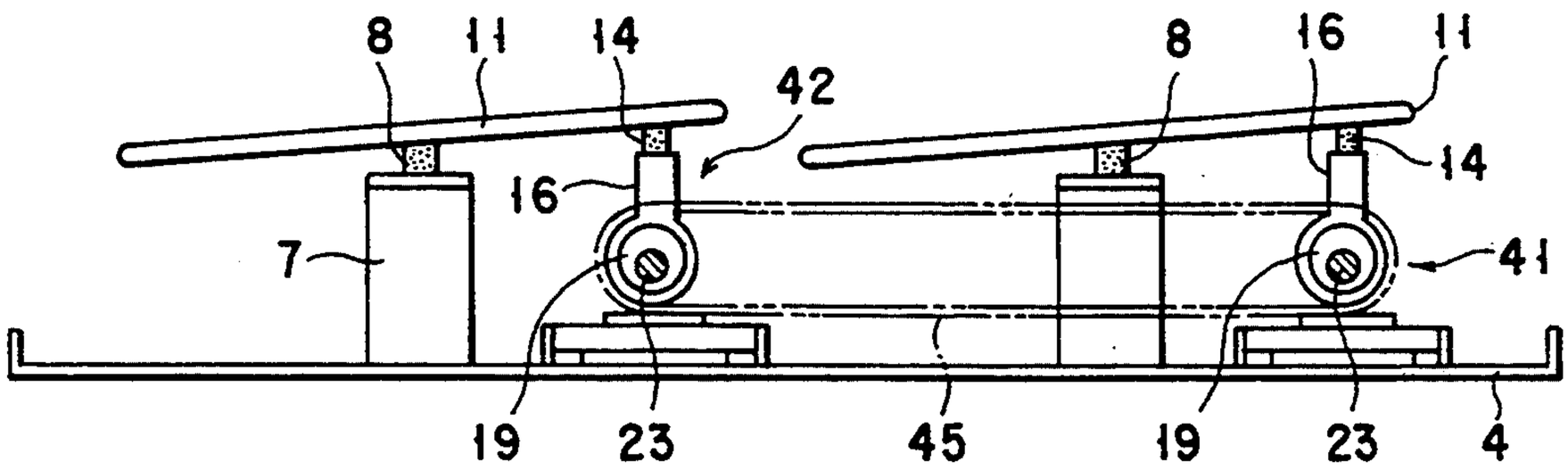
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FIG. 11

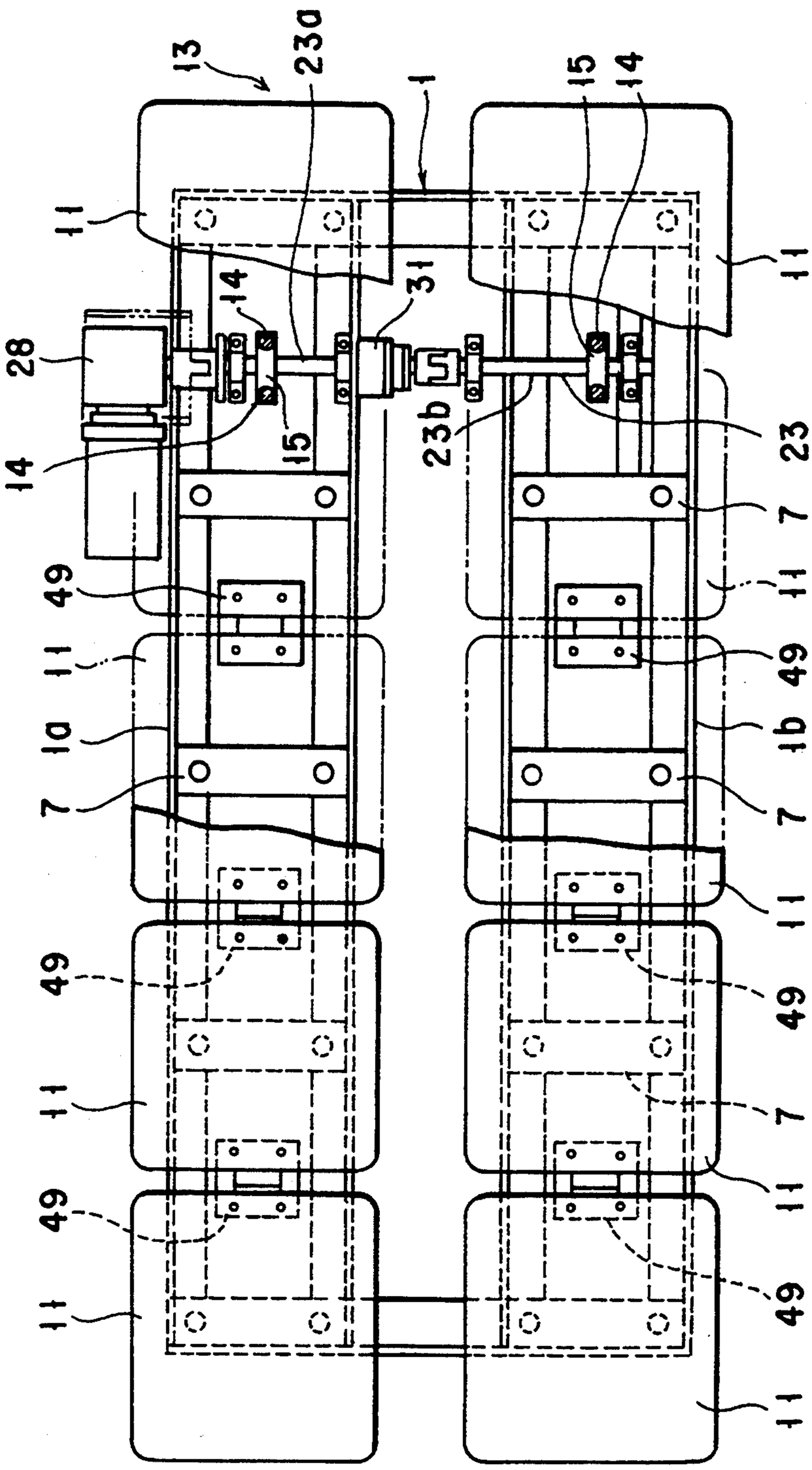


FIG. 12

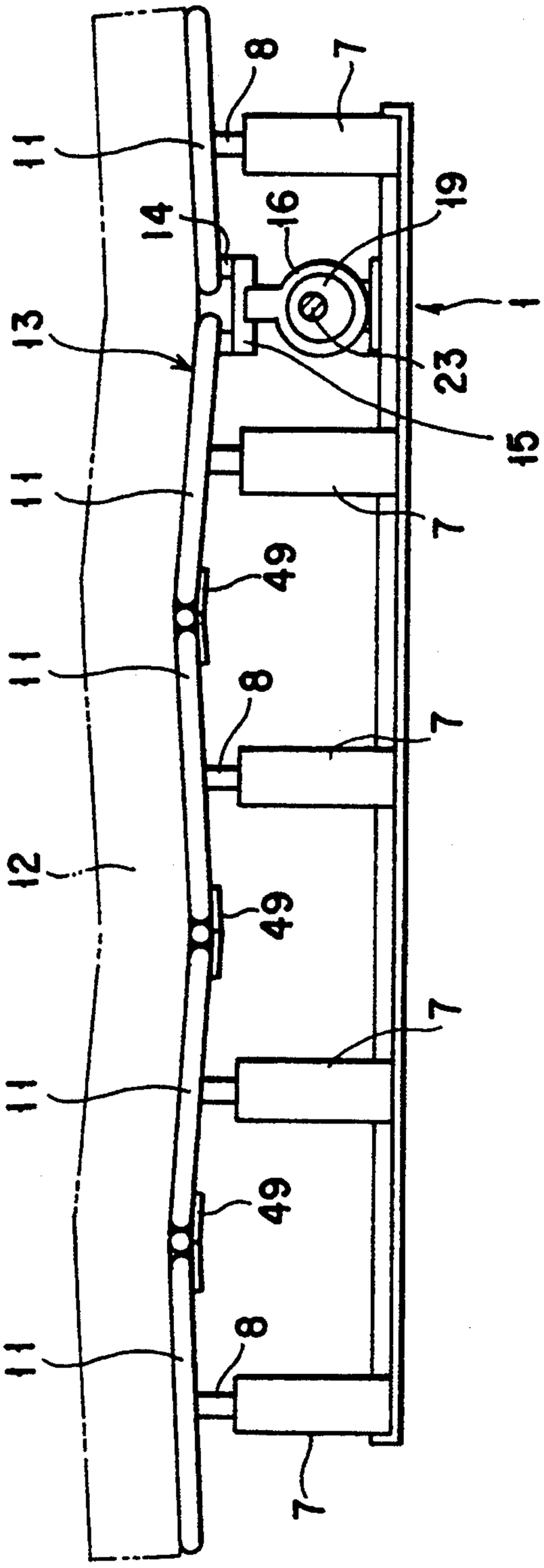


FIG. 13

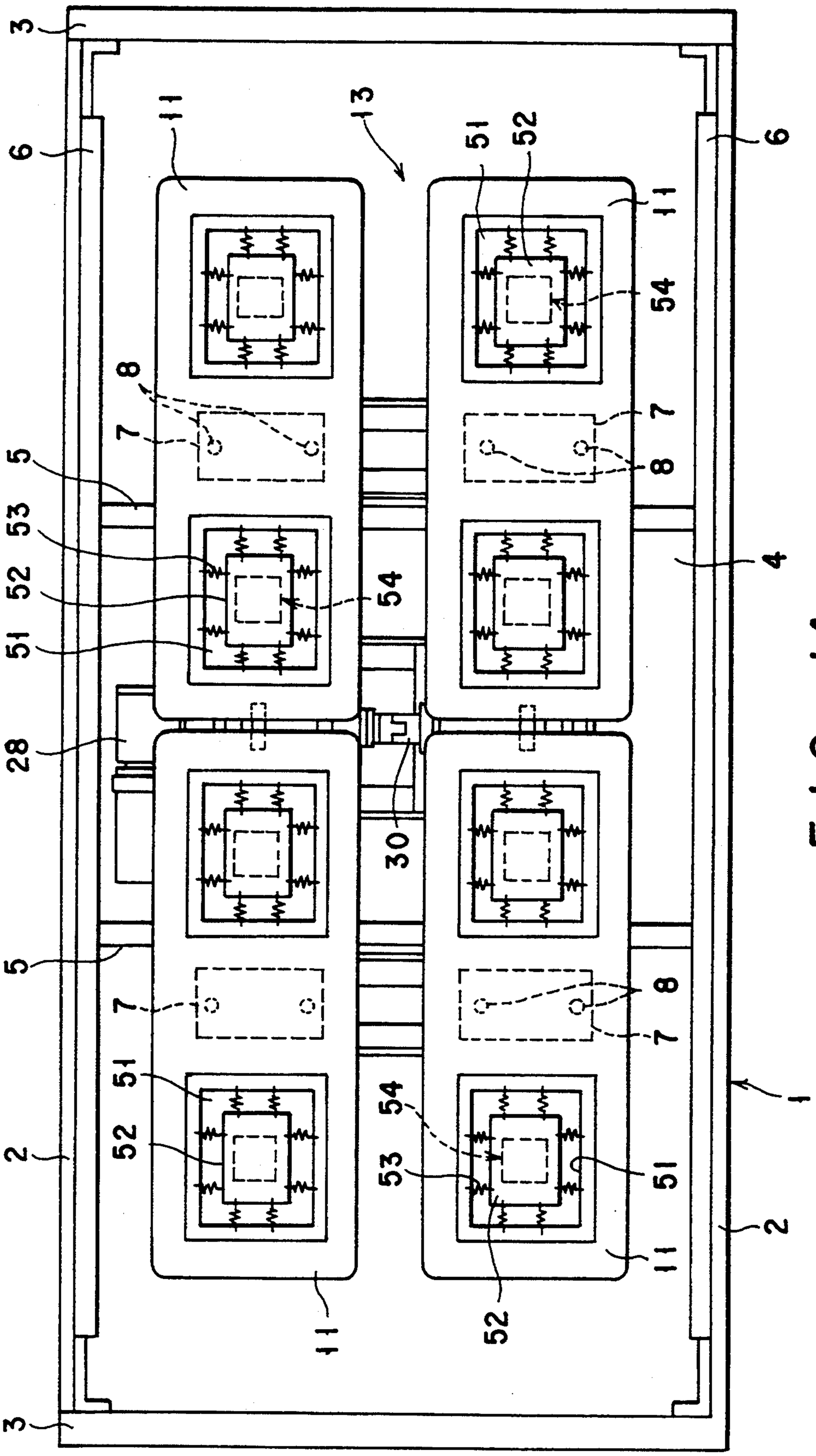
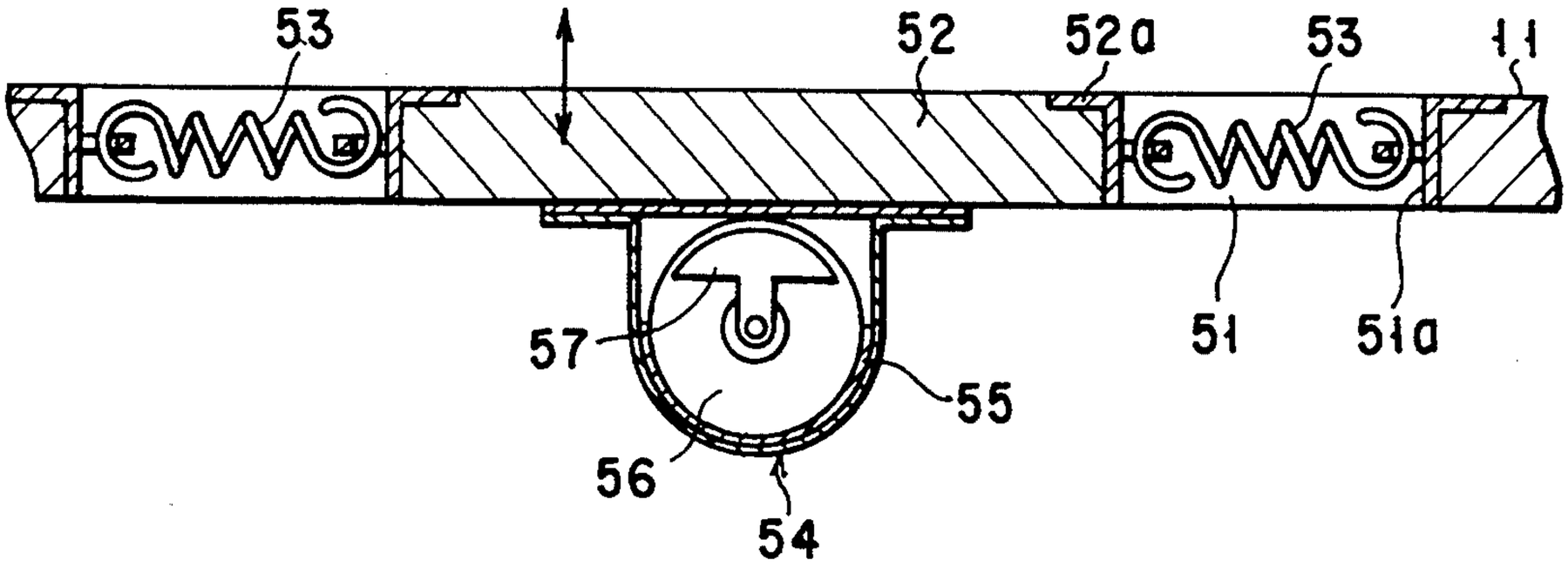


FIG. 14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52a
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51a
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FIG. 15

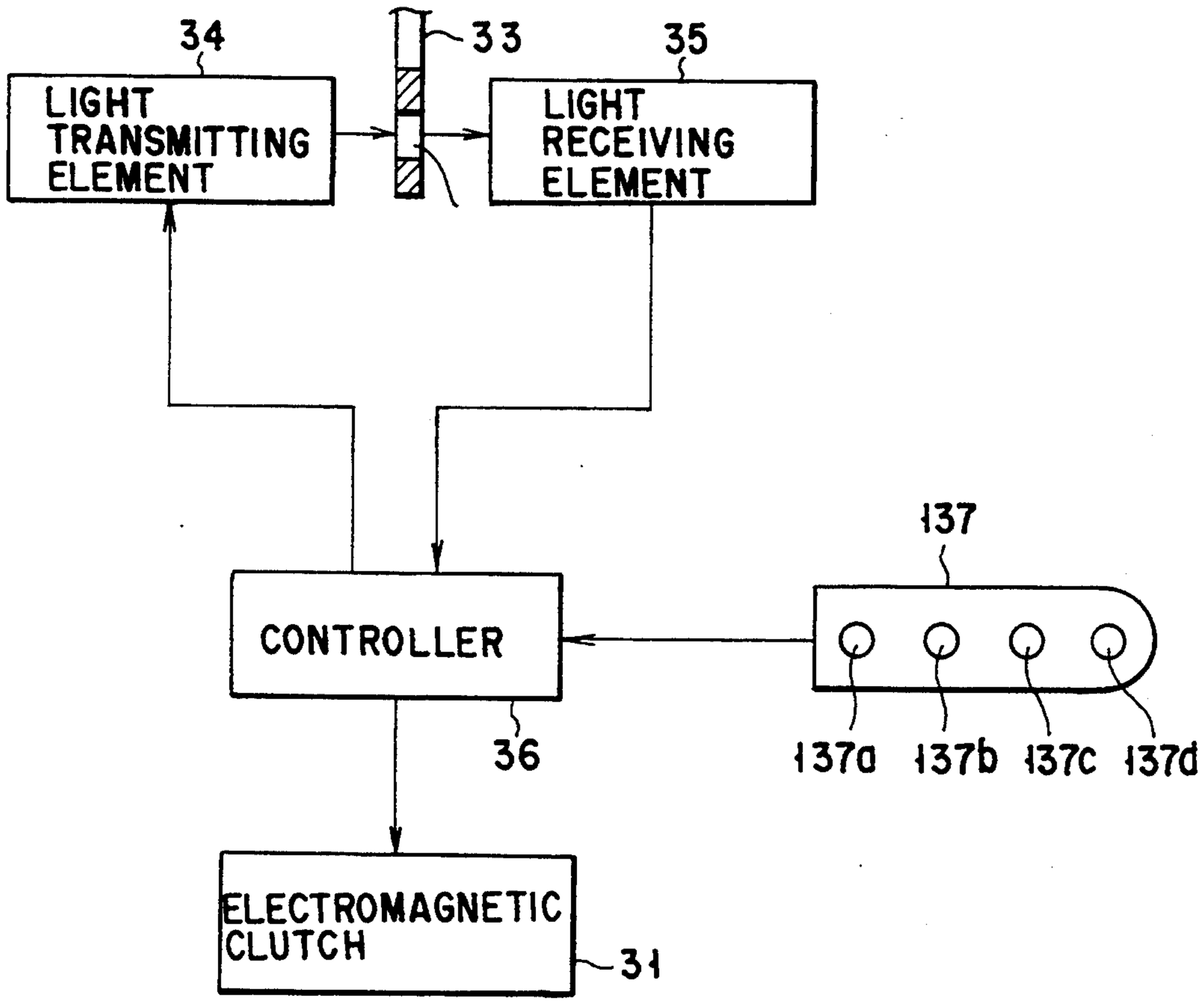

34
33
35
LIGHT TRANSMITTING ELEMENT
LIGHT RECEIVING ELEMENT
137
CONTROLLER
36
137a
137b
137c
137d
ELECTROMAGNETIC CLUTCH
31

FIG. 16

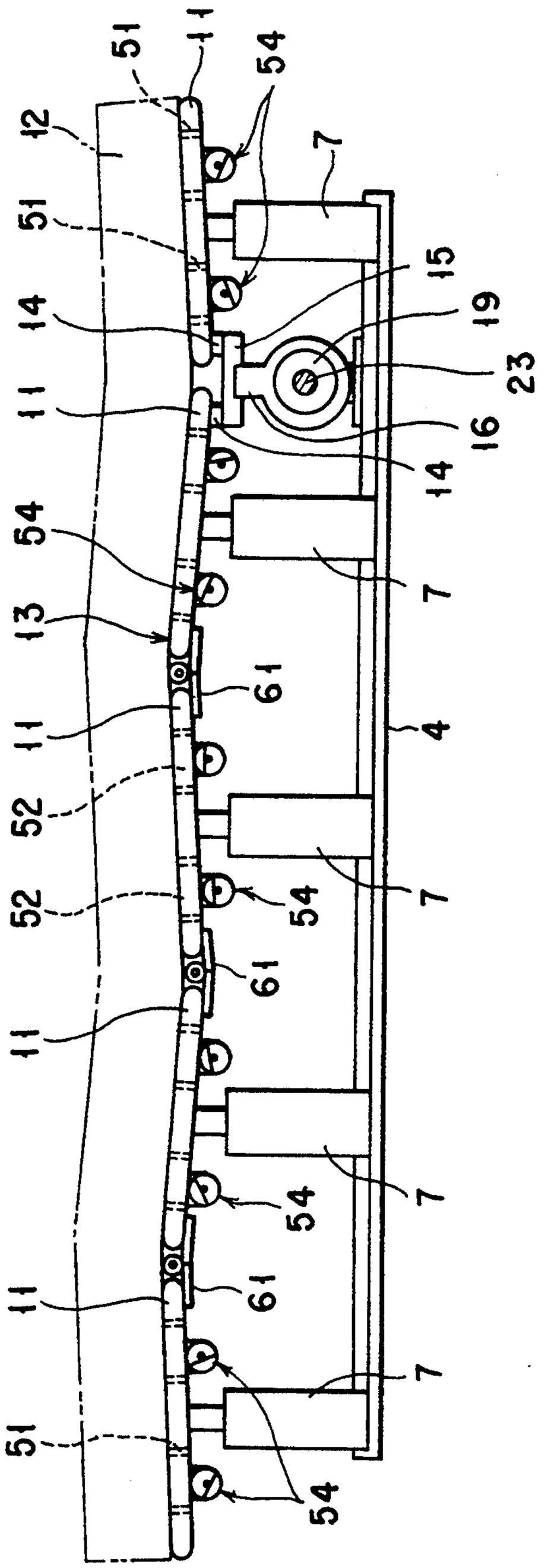
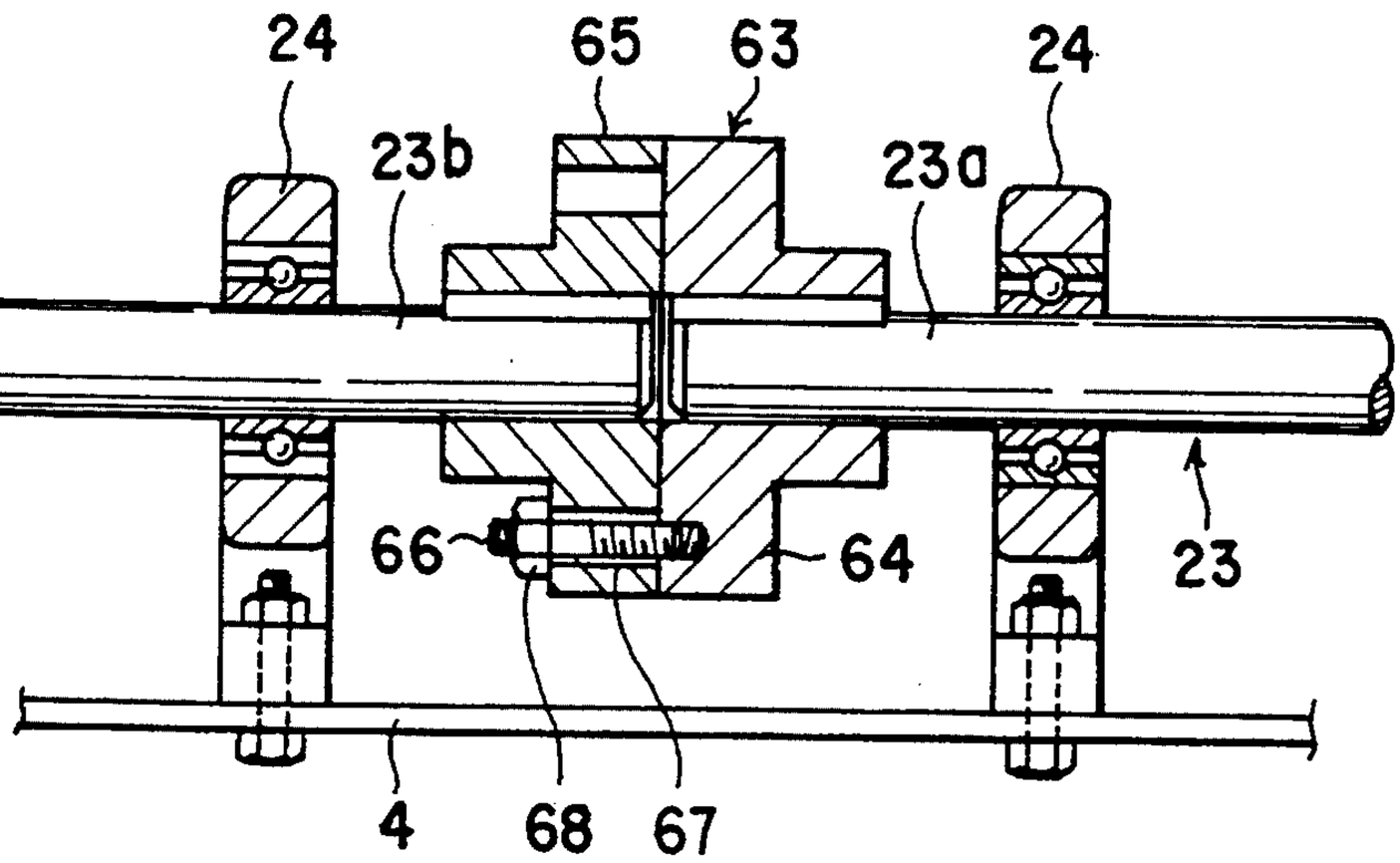


FIG. 17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23b
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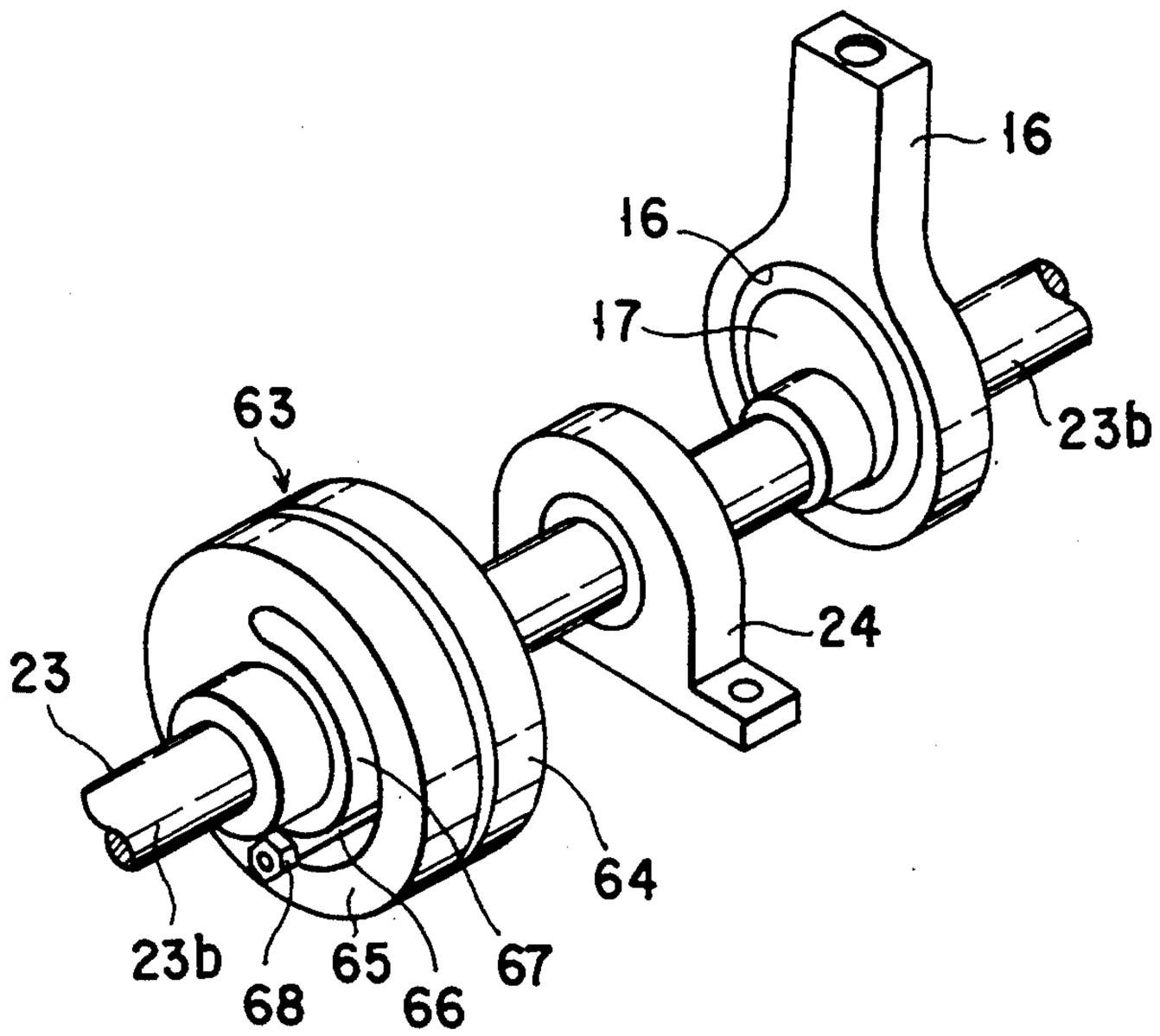
FIG. 18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23b
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66
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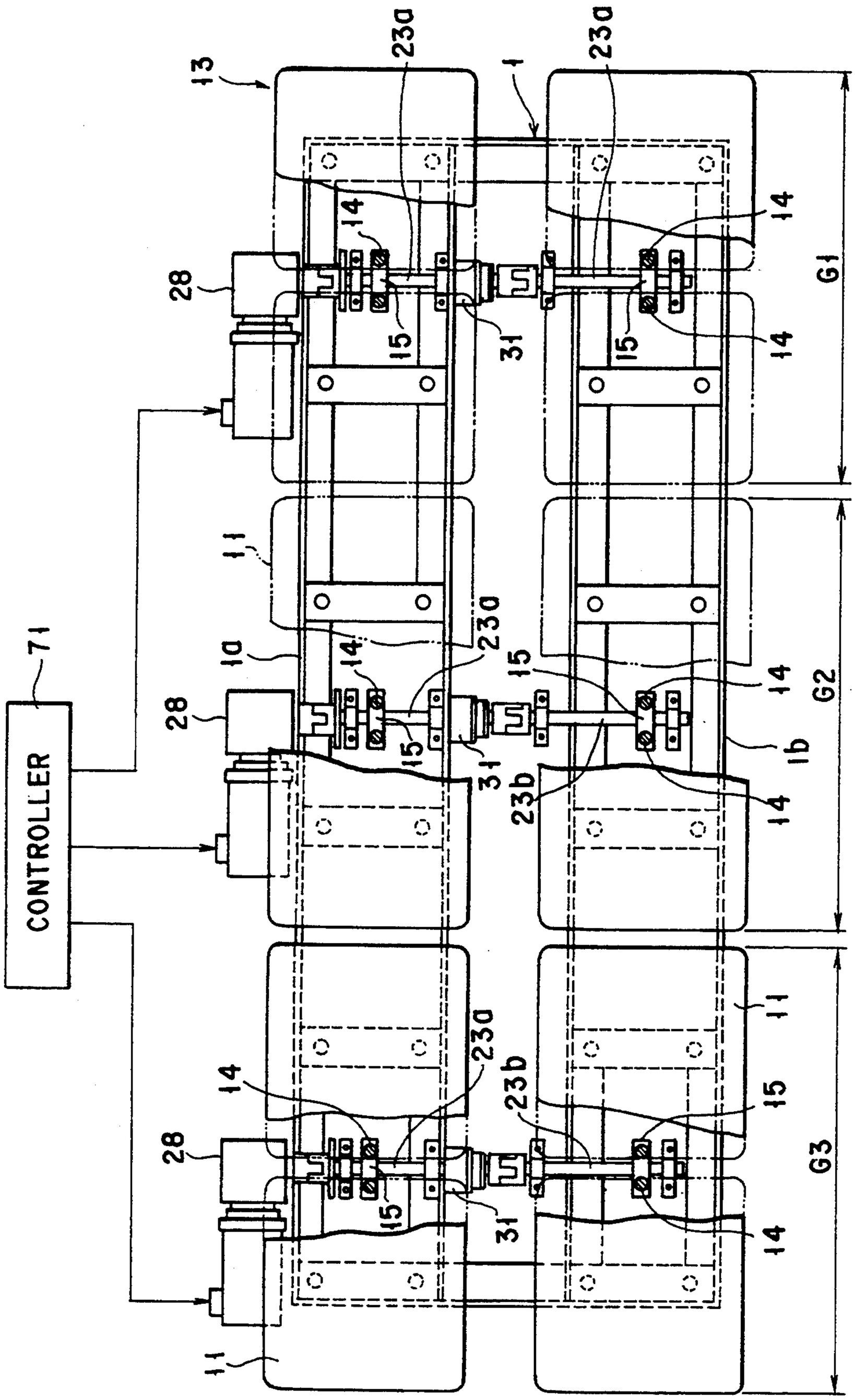
FIG. 19


CONTROLLER
71
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2
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23a
14
15
14
28
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23b
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G2
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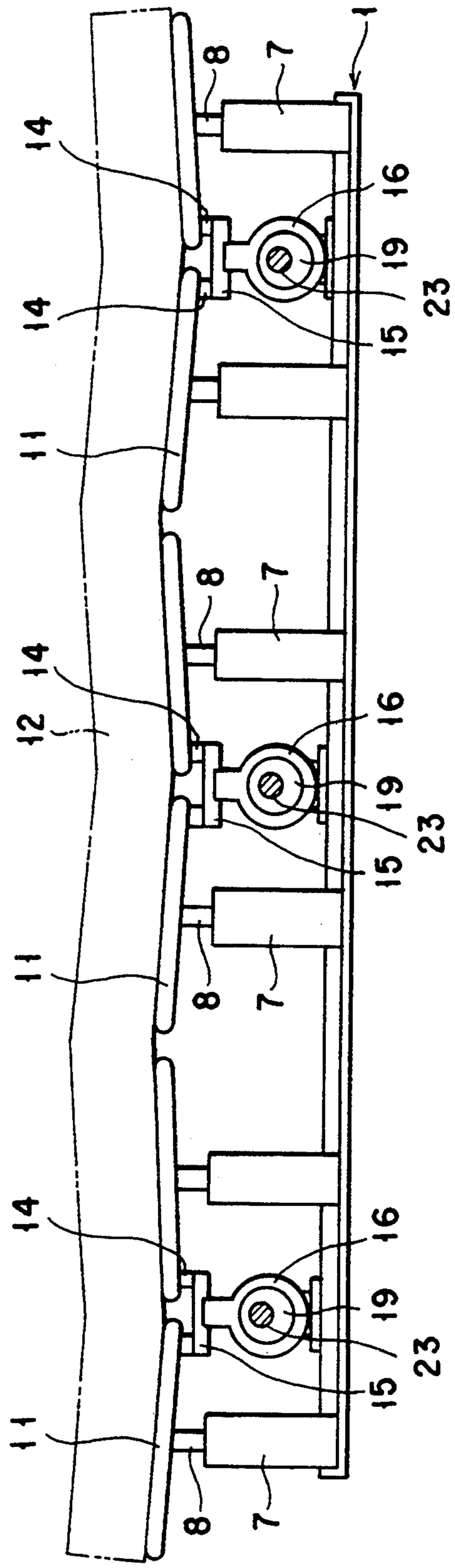
14
G3
11

FIG. 20



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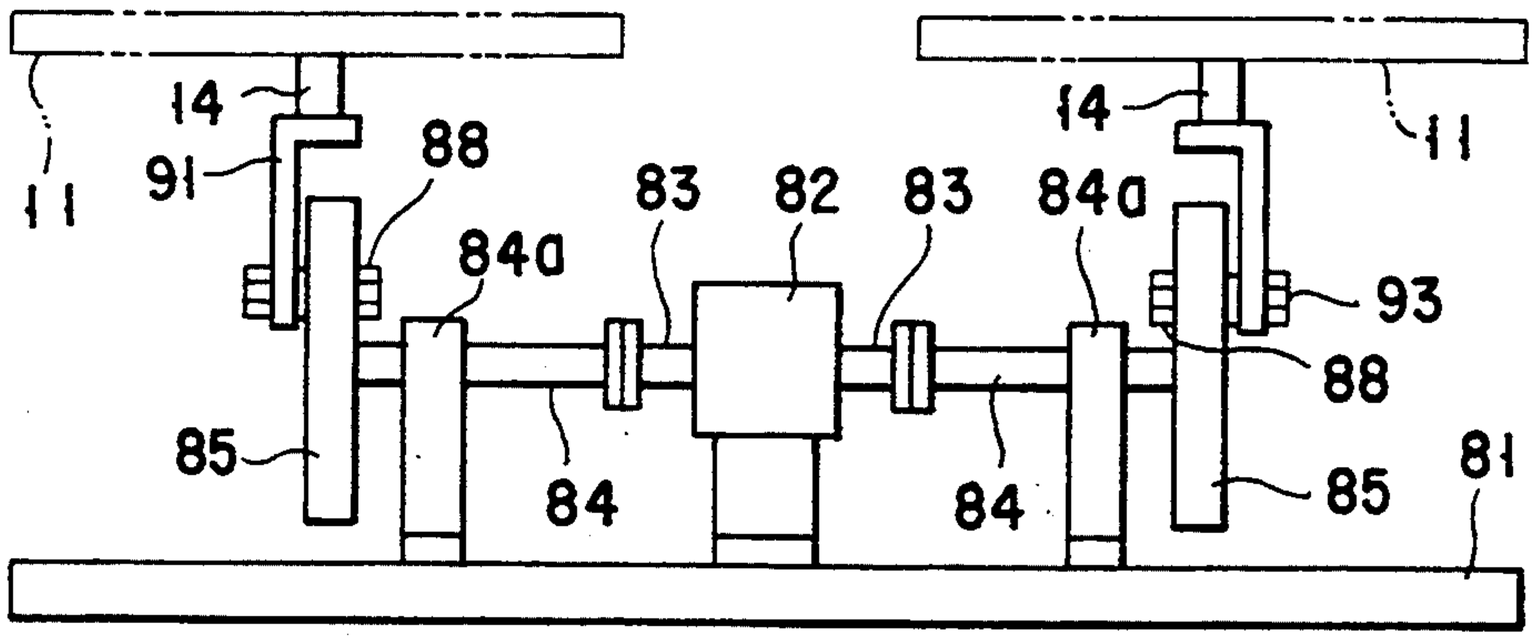
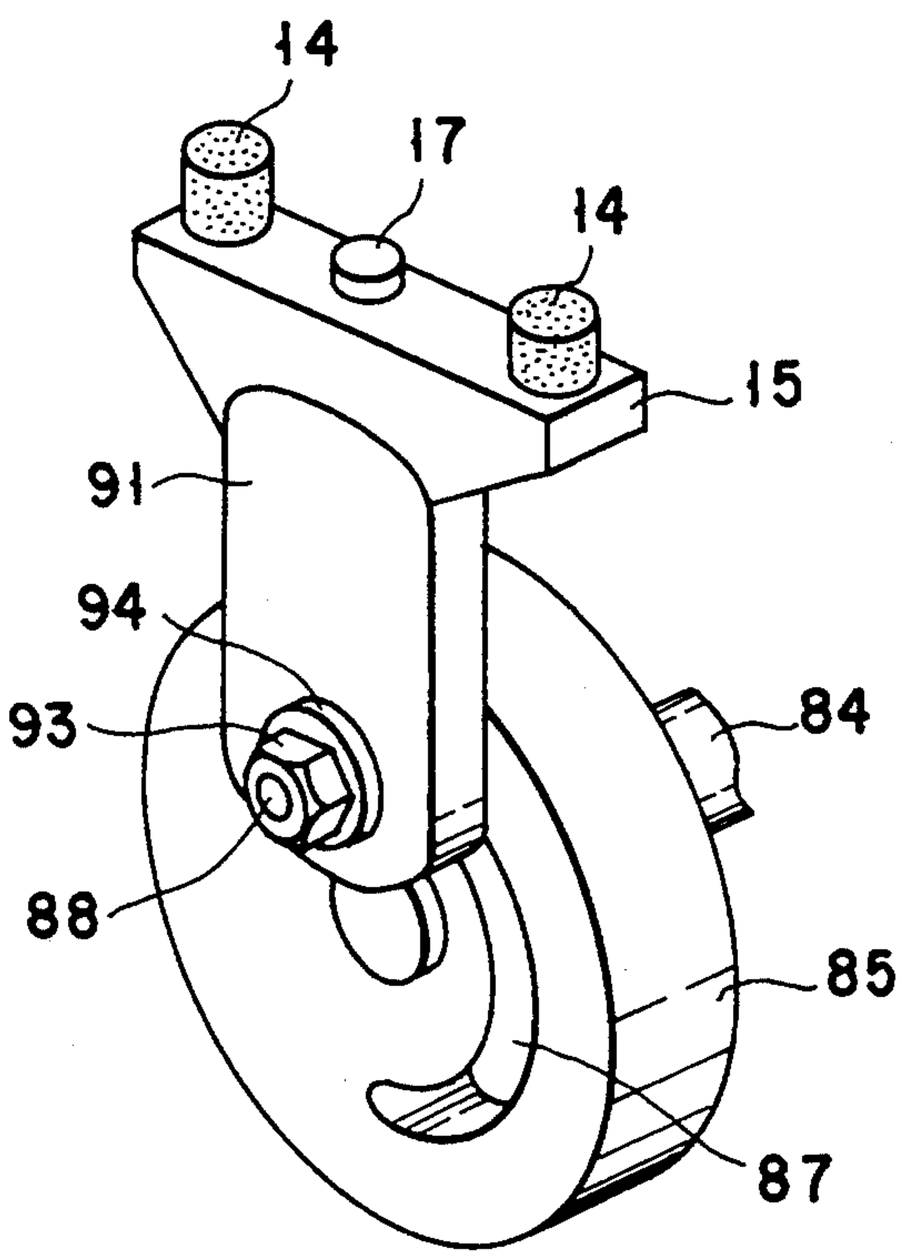


FIG. 22



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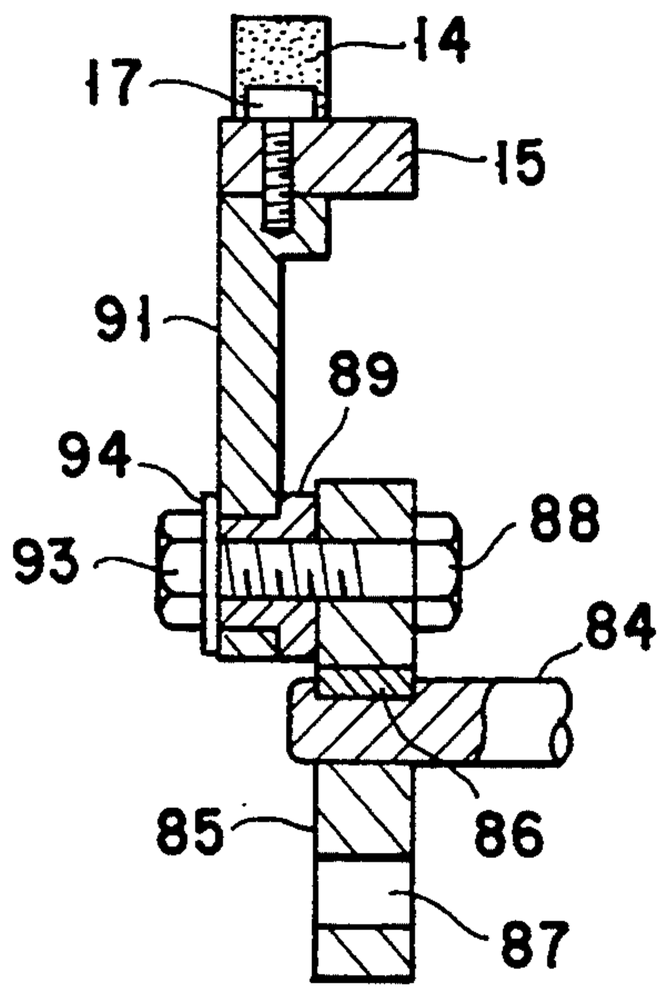
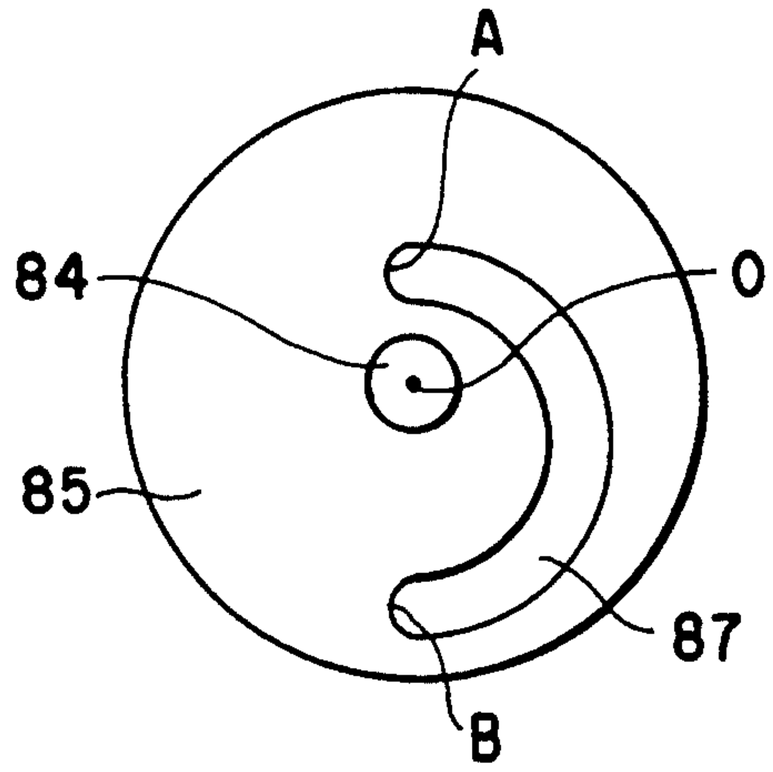


FIG. 24


A
84
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85
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B

FIG. 25

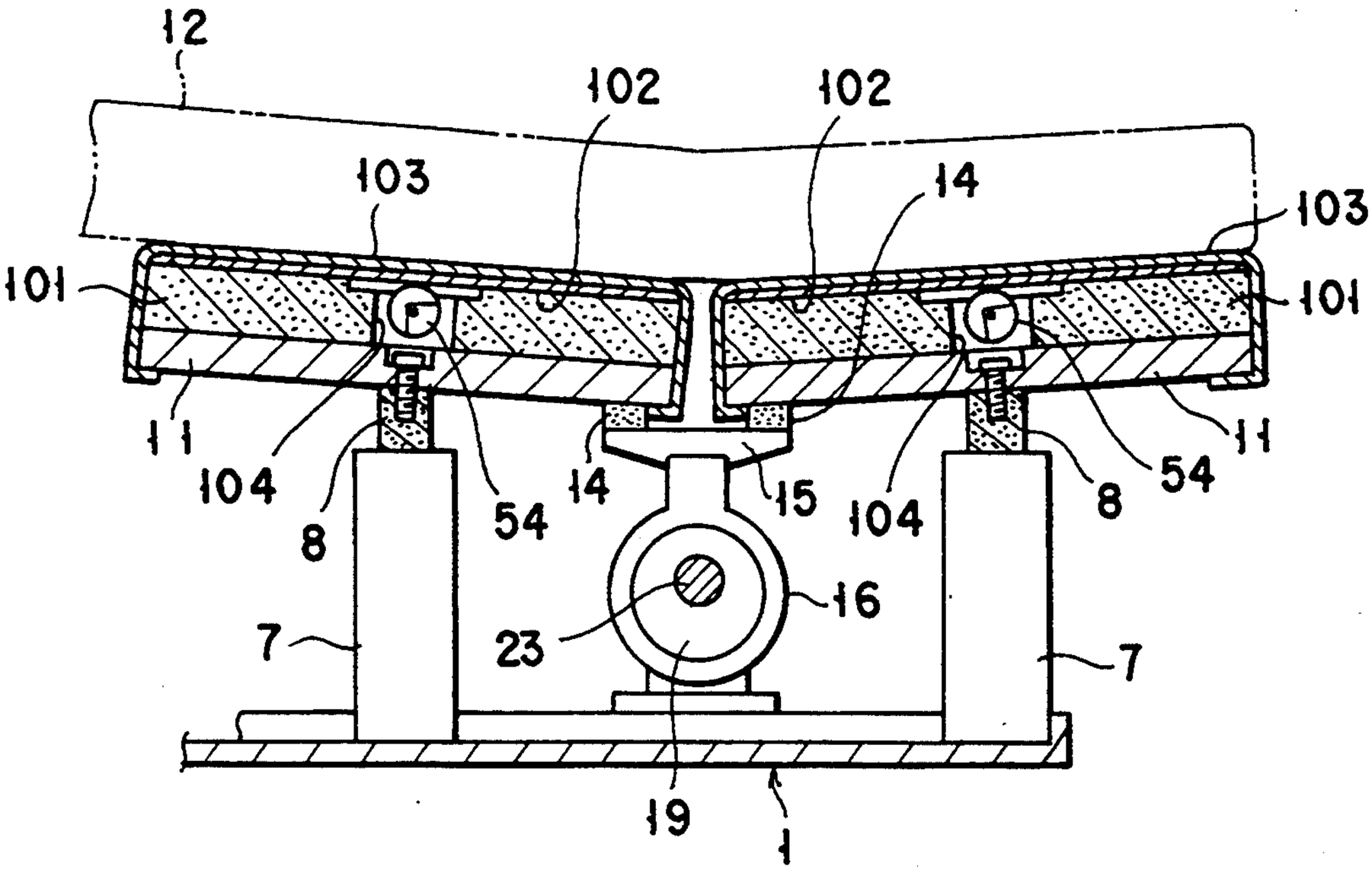
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FIG. 26

BED APPARATUS AND METHOD FOR DRIVING A BEDSTEAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a bed apparatus utilized to maintain the body of a user to be in a good and healthy position and to a method for driving its bedstead.

2. Description of the Related Art

Generally, a bed apparatus is utilized to lie on a mattress for sleep. In order to provide added value, various functions are imparted to the bed apparatus.

Recently, various bed apparatuses have aroused the user's attention for slimming and healthy exercise and they are placed on the market. In order to maintain the user's body slim and healthy it is required that adequate exercise be given to him and her in a lying position on a mattress so as to eliminate any excess build-up of fat in the body.

Adequate exercise ensures better blood circulation and excellent health. For the bed-ridden elderly and sick for instance it is possible to enjoy body exercise and thus to regain various functions of the body through the exercise. Further such bed apparatuses are utilized to, for example, induce sleep in the user by providing a comfortable rocking mode and to rouse the user from sleep with a strong, disturbing mode.

The user, if being rocked on the mattress to the right and left, can be given a roll-over movement. For the sick and elderly bed-ridden for a long period of time it is possible to prevent bedsores by providing a roll-over motion on the mattress at an adequately slow speed.

It is very convenient for the user to be given healthy and slimming exercise or body-function improving exercise on the mattress or to enjoy such exercise on the mattress of the present bed apparatus.

SUMMARY OF THE INVENTION

It is accordingly the object of the present invention to provide a bed apparatus and a method for driving a bedstead which enable a user to simply sleep a comfortable sleep or to be given, or enjoy, slimming exercise for health and aesthetic purposes.

In a preferred aspect of the present invention a bed apparatus is provided which comprises a bedframe; a bedstead divided into a plurality of separation pieces, the separation pieces being swingable or rockable; a drive shaft rotatably mounted on the bedframe; and power transmitting means for converting rotation motion of the drive shaft to an up and down motion and for swinging the separation pieces of the bedstead by the up/down motion.

In the invention as claimed in claim **15**, a bed apparatus is provided which comprises a bedframe, a bedstead divided into a plurality of separation pieces and swingably mounted on the bedframe in a given array, drive means for swingably driving the separation pieces for each of groups into which the separation pieces are grouped and control means for controlling the swinging drive of the separation pieces for each group.

According to the bed apparatus as claimed in claim **1**, the separation pieces constituting a bedstead are swingably driven to impart swinging motion to the user and can be controlled in their swing motion phase so that various extents and kinds of exercise can be given to the user.

According to the bed apparatus as claimed in claim **15**, the swinging or rocking of the separation pieces can be controlled for each group so that their swing motion pattern can be set for each group of the separation pieces.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

FIG. **1** is a plan view showing a bed apparatus according to a first embodiment of the present invention;

FIG. **2** is a cross-sectional view taken along line II—II in FIG. **1**;

FIG. **3** is a cross-sectional view taken along line III—III in FIG. **1**;

FIG. **4** is a perspective view showing a drive mechanism for swingably driving separation pieces in a bedstead;

FIG. **5** is a cross-sectional view showing a mattress bent at a middle area in its longitudinal direction;

FIG. **6** is a cross-sectional view showing a mattress bent in a width direction;

FIG. **7** is a cross-sectional view showing a coupling mechanism for a support member and a separation piece of a bedstead;

FIG. **8** is a side view showing a slit plate for controlling the swing motion phase of the separation pieces;

FIG. **9** is a circuit diagram for controlling swing motion of the separation pieces;

FIG. **10** is a plan view showing a second embodiment of the present invention;

FIG. **11** is a side view showing the second embodiment;

FIG. **12** is a plan view showing a bed apparatus according to a third embodiment of the present invention;

FIG. **13** is a side view showing the bed apparatus of FIG. **12**;

FIG. **14** is a plan view showing a bed apparatus according to a fourth embodiment of the present invention;

FIG. **15** is an enlarged cross-sectional view showing the fourth embodiment;

FIG. **16** shows a control circuit for the fourth embodiment;

FIG. **17** is a side view showing a bed apparatus according to a fifth embodiment of the present invention;

FIG. **18** is a cross-sectional view showing a drive mechanism for controlling the swing motion phase of separation pieces in a sixth embodiment of the present invention;

FIG. **19** is a perspective view showing the drive mechanism of FIG. **18**;

FIG. 20 is a plan view showing a bed apparatus according to a seventh embodiment of the present invention;

FIG. 21 is a side view showing the seventh embodiment;

FIG. 22 is a side view showing a bed apparatus, along a width direction, according to an eighth embodiment of the present invention;

FIG. 23 is a perspective view showing a rotation disk and arm of the eighth embodiment;

FIG. 24 is a cross-sectional view showing the rotation disk and arm of FIG. 23;

FIG. 25 is a side view showing the rotation disk of FIG. 24; and

FIG. 26 is a cross-sectional view, as taken along a longitudinal direction, showing a bed apparatus according to a ninth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment of the present invention will be explained below with reference to the accompanying drawings.

FIGS. 1 to 9 show a first embodiment of the present invention. A bed apparatus as shown in FIG. 1 includes a rectangular bedframe 1 having a pair of side plates 2 and a pair of end plates 3. A base member 4 is arranged inside the bedframe 1 and is formed of a small rectangular frame-like member. The base member 4 is coupled to the bedframe 1 by a pair of joint bars 5 arranged along a width direction of the bedframe. The joint bar 5 is comprised of a band-like member with each end portion upwardly bent and fixed to a corresponding rail 6, as shown in FIG. 3, provided on the inner surface of the side plate 2. The joint bar is coupled at its middle portion to the base member 4.

Four support members 7 are uprightly arranged one at each corner area of the rectangular base member 4 along the width direction of the bedframe 1. A pair of coupling members 8 is provided at an upper end area of each support member 7 along a III—III direction of FIG. 1 and each comprised of an elastic member 8*a* (of FIG. 7), such as rubber, serving as a support member and a pair of bolts 8*b* having their head portions buried in the elastic member 8*a* and their threaded portions projected out of the corresponding ends of the elastic member 8*a*. One of the pair of bolts is fixed by nut 9 to the surface of the support member 7 and slender, rectangular, plate-like separation pieces 11, 11 are each fixed by another nut 9 and another bolt 8*b* of the coupling member 8 at an intermediate area of the length of the separation piece whereby the separation piece 11 is swingably mounted about its intermediate area.

The separation piece 11 is coupled to the upper surface of the four support members 7. In this way, the two separation pieces 11 are arranged in two arrays in a longitudinal direction of the bed frame 1 and a bendable mattress 12 is disposed over the upper surface of the separation pieces 11 as indicated by a dash-dot line in FIG. 2. In this embodiment, a bedstead 13 over which the mattress 12 is disposed is comprised of the four separation pieces 11.

As shown in FIG. 2, coupling members 14 similar in structure to the coupling members 8 have their one-end side fixed to the lower surfaces of the middle areas of mutually adjacent end portions of the separation pieces 11 as viewed in a width direction as shown in FIG. 2. The other-end side of the coupling member 14 is fixed to a single coupling tool 15.

Those adjacent separation pieces 11, at each array, coupled by the coupling tool 15 are swingable about that area, while elastically deforming the coupling member 14, which is coupled to the support member 7 by the coupling member 8.

As shown in FIGS. 3 and 4, the coupling tool 15 is fixedly coupled by a corresponding bolt 17 to the upper end face of a corresponding movable arm 16 constituting a power drive means. A mount hole 18 is provided at a lower-end side of the movable arm 16 and a circular disk 19 is rotatably mounted in the mount hole 18 through a dry bearing 21. An eccentric hole 22 is provided in an eccentric relation to the rotation center of the disk 19.

A drive shaft 23 extends through those eccentric holes 22 of the disks 19 of those paired movable arms 16 arranged along the width direction of the bedframe 1. The drive shaft 23 is divided into a drive shaft section 23*a* and driven shaft section 23*b*. The drive shaft section 23*a* and driven shaft section 23*b* are arranged in an aligned relation and rotatably journalled in associated bearings 24.

An intermediate portion of the drive shaft section 23*a* passed through the eccentric hole 22 is nonrotatably coupled by a key 25 to one disk 19 and an intermediate portion of the driven shaft section 23*b* is coupled by a key 25 to the other disk 19. In order to prevent the disk 19 from being detached from the mount hole 18 a pair of pressing plates 26 larger in diameter than the mount hole 18 are fixed relative to the corresponding disk 19.

The drive shaft section 23*a* of the drive shaft 23 is connected at one end to an output shaft 29 of a drive source 28 by a first coupling 27 and at the other end to a rotor side 31*a* of an electromagnetic clutch 31. One end of the driven shaft section 21*b* of the drive shaft 23 is coupled by a second coupling 30 to the armature side 31*b* of the electromagnetic clutch 31. The rotor side 31*a* and armature side 31*b* are held in a field 31*c* corresponding to a stationary section.

A disk-like slit plate 33 is mounted on one-end side of the drive shaft section 23*a* of the drive shaft 23 and has four through-holes 32 at intervals of 90° in a circumferential direction as shown in FIG. 8. A light transmitting element 34, such as a light emitting diode, is disposed on one surface side and a light receiving element 35, such as a phototransistor, is disposed on the other surface side of the slit plate 33 in an opposed relation to the element 34 as shown in FIG. 9.

The light transmitting element 34 emits light upon receipt of a drive signal coming from a controller 36 disposed on the base member 4 and the light receiving element 35 delivers, to the controller 36, a detection signal involved upon receipt of light from the light transmitting element 34 via the through-hole 32 in the slit plate 33. An operator-side operation section 37 is connected to the controller 36 and the electromagnetic clutch as set out above is electrically connected to the controller 31 so as to be controlled, as set out above, in accordance with a detection signal coming from the light receiving element 35.

A power source switch 37*a*, operation switch 37*b* and speed control switch 36*c* are provided in the operator-side operation section 37. With the power source switch 37*a* in an ON state, electric power is fed to the drive source 28, electromagnetic clutch 31 and light transmitting element 34. The operation of the drive source 28

leads to the rotational drive of the drive shaft **23**. The rotation of the drive shaft **23** causes the eccentric rotation of the disk **19** eccentrically fitted over the drive and driven shaft sections **23***a* and **23***b*, resulting in an up and down movement of the paired movable arms **16** due to the eccentric rotation.

The coupling tool **15** as set out above is provided on the upper end of the respective movable arm **16** and coupled by the coupling members **14** to the adjacent ends of the paired separation pieces **11** arranged in the longitudinal direction of the bedframe **1**. The up/down movement of the movable arm **16** causes the adjacent end portions of the paired separation pieces **11** to be moved in the up and down direction or in push/pull motion and hence the paired separation pieces **11**, while being bent to a varying extent, swingably moves the coupling member **8** which is mounted on the upper end of the support member **7**.

The swinging movement of the respective paired separation pieces **11** along the width direction of the bedframe **1**, that is, the swinging movement of the separation pieces **11** in the one array and in the other can be subjected to phase control. In order to make such phase control, the operation switch **37***b* on the operator-side operation switch **37***b* is switched ON and the carrying of electric current into the electromagnetic clutch **31** is interrupted by a signal from the light transmitting element **34** via the though-hole **32** in the slit plate **33** which is first detected by the light receiving element **35**. In other words, the driven shaft section **23***b* of the drive shaft **23** is separated from the drive shaft section **23***a* whereby the drive shaft section **23***a* alone is rotated by the drive source **28**.

After being separated from the drive shaft section **23***a* the driven shaft section **23***b* is not rotated by an inertial force because a load is borne on the driven shaft section **23***b*.

The rotational drive of the drive shaft section **23***a* alone swingably moves only one array of separation pieces **11** along the width direction of the bedframe **1**. When the light receiving element **35** detects the next light from the light transmitting element **34**, that is, when the slit plat **33** is rotated through an angle of 90° and light receiving element receives that light via the next adjacent through-hole **32** corresponding to the 90° rotation of the slit plate **33**, electric power is supplied by a corresponding detected signal to the electromagnetic clutch **31** so that the drive and driven shaft sections **23***a* and **23***b* of the drive shaft **23** are connected to each other. As a result, the separation pieces **11** in the other array restart swinging movement, along the width direction of the bedframe **1**, in a 90° phase delayed relation to the one-array side separation pieces **11**. In other words, the separation pieces **11** on the one array side and those on the other array side can be swung, along the width direction of the bedframe **1**, in a seqùential 90° phase shift relation by switching the operation switch **37***b* ON at a time.

Put it in more detail, if the operation switch **27***b* is switched ON when the paired left and right separation pieces **11** are swung in the same phase, that is, in the same state, the phase with which the paired right and left separation pieces **11** are swung can be 90° delayed. If in this state the operation switch **27***b* is again switched ON, then the phase as set out above can be delayed by another 90° , that is, a 180° phase shift is achieved from the initial state so that it is possible to reverse the upward and downward swinging movements of the paired right and left separation pieces **11**. To be specific, the paired separation pieces **11** in the right and left arrays can be controlled in three phase steps of 0°, 90° and 180° in swinging motion.

When the speed control switch **37***c* of the operation section **37** is rotationally operated, then the rotation rate of the drive shaft **23** by the drive source **28** is steplessly controlled and it is possible to adjust the speed with which the paired separation pieces **11** are swung.

According to the bed apparatus thus arranged, the user can operate the drive source **28** in a lying-on-the-back position so that the drive shaft **23** is rotated by the drive source **28**. If, by so doing, the paired right and left separation pieces **11** are swung, for example, with the same phase, then the mattress **12** is bent at a middle area along the longitudinal direction as shown in FIG. **5** so that the waist of the user's body can repeatedly be bent. It is thus possible to do slimming exercise for health so that any excess deposition of fat in the waist can be eliminated.

In case where the phase with which the right and left separation pieces **11** are swung is varied through an angle of 90° for instance, the mattress **12** is bent not only at a middle area in the longitudinal direction but also at a middle area in the width direction in up/down motion, that is, in the right and left directions as shown in FIG. **6**. To be specific, the mattress **12** is twisted in the width direction. The extent of the twist motion is adjusted in a phase shift range of 0° to 180° where there is no twist for 0° and a maximum twist for 180°.

In other words, the swinging movement of the paired separation pieces **11** in the one array side as caused by the drive shaft section **23***a* follows that of the paired separation pieces **11** in the other array side as caused by the driven shaft section **23***b*. A twist is given to the mattress upon the alternation of the upward and downward swinging motions of the two paired arrays.

In accordance with these motions the body of the user is given right/left twist motion when being bent at the waist area. It is possible to impart adequate exercise to the user with a greater effect than in the case where the paired right and left separation pieces **11** have the same swing phase position.

If the rotation speed of the drive shaft **23** is delayed by the speed control switch **37***c* the body of the user, while swaying just as in a cradle, can be given adequate rest in a comfortable state. Further, the user can enjoy roll-over motion in a bed in right/left motion. For the user, such as the sick and elderly bed-ridden for a long period of time it is possible to experience the aforementioned roll-over motion on the mattress at a slow rate of speed and to prevent a possible bedsore.

The swing phase of the paired right and left separation pieces **11**, being shifted by another 90°, that is, being shifted to 180°, enables greater lateral twist motion (roll-over motion) to be imparted to the user than in the case of the phase being 90°. It is, therefore, possible to give adequate exercise to the user effectively.

To be specific, the user can select the kind, extent, etc., of exercise when occasion arises.

The second to ninth embodiments of the present invention will now be explained below. In these embodiments the same reference numeral is employed to designate parts or elements corresponding to those shown in the first embodiment of the present invention.

FIGS. **10** and **11** show a second embodiment of the present invention. The second embodiment of the present invention is similar to the first embodiment except

that a bedstead **13** is comprised of four separation pieces **11**, but is different from the first embodiment in that it is possible to control a swing phase for a pair of separation pieces **11**, right and left, on one-end side and pair of separation pieces **11**, right and left, on the other-end side of a length of bedframe **1**.

To be specific, a first drive mechanism **41** is arranged on one-end side of the length of the bedframe **1** and a second drive mechanism **42** is arranged somewhat more to the other-end side than at a middle. The drive mechanisms **41** and **42** each comprise a drive shaft **23** divided into a drive shaft section **23***a* and driven shaft section **23***b* disconnectable by an electromagnetic clutch **31** from each other and a pair of movable arms **16** driven in an up and down motion by the rotation of the drive shaft **23**.

The drive shaft section **23***a* of the first drive mechanism **41** is connected to an output shaft **29** of a drive source **28**. A drive pulley **43** is fitted over the output shaft **29** and a driven pulley **44** is fitted over one end portion of a drive shaft section **23***a* of the second drive mechanism **42**. A belt **45** is run between the pulleys **43** and **44**. The first drive mechanism **41** is driven directly by the drive source **28** and the second drive mechanism **42** is of such a type that drive power from a drive source **28** is transmitted by the belt **45**.

It is to be noted that the electromagnetic clutch **31** of the respective drive mechanisms **41** and **42** can be controlled through a controller **36** and operator-side operation section **37** as in the case of the first embodiment.

According to the second embodiment thus arranged, the paired separation pieces **11** in the one array situated on one end side of the bedframe **1** as viewed in a width direction, that is, on the drive shaft section **23***a* side of the drive shaft **23** as shown in FIG. **11** can be swung with the same phase and the paired separation pieces **11** in the other array can have its swing phase controlled relative to the paired separation pieces **11** on the one array side.

Further, the swinging movements of the paired separation pieces **11** in the two arrays are such that one adjacent end of one paired separation pieces is moved downward while, on the other hand, the adjacent end of the other paired separation pieces is moved upward as shown in FIG. **11**. Even in this case, the user can enjoy different motion from that in the first embodiment.

FIGS. **12** and **13** show a third embodiment of the present invention. In this embodiment a rectangular bedframe **1** has a frame section **1***a* on one side and frame section **1***b* on the other side as viewed in a width direction of the bedframe **1**. A plurality of support members are uprightly arranged at a predetermined interval on the respective frame sections **1***a* and **1***b* along the length of the bedframe and, each, are comprised of a gate-like support member formed of a bent band-like member.

Separation pieces **11** constituting a bedstead **13** are provided on the respective support members **7**. To be specific, **10** separation pieces **11** are arranged in two 5-successive units along the length of the bedframe, i.e., in two parallel arrays as viewed across the width of the bedframe. The respective separation pieces **11** are swingably coupled by coupling members **8** to, and supported on, the upper surfaces of the respective support members **7**.

Of those 5 successive separation pieces **11**, 4 successive separation pieces **11** except one arranged on one side of the bedframe **1** are bendably coupled by hinges **49** at their mutual adjacent end portions to each other.

The respective one-end portions of a corresponding coupling member **14** are coupled to the lower surfaces of the corresponding end portions of the separation piece **11** on the one-end side of the bedframe **1** and adjacent separation piece **11**. The other end of the coupling member **14** is coupled to a coupling tool **15** mounted on the upper end of a movable arm **16**.

As in the first embodiment, one of a pair of movable arms **16** is driven in up/down motion through a disk **19** which is eccentrically rotated by a drive shaft section **23***a* of a drive shaft **23**. The other movable arm **16** is mounted on a driven shaft section **23***b*.

According to the bed apparatus thus arranged, if the user operates a drive source **28** in a lying-on-the-back position on a mattress **12** to cause the two serially-arranged separation piece groups, right and left, to be moved in the same swing phase, then the respective separation pieces in the right and left separation piece groups are bendable in a serpentine curve including a plurality of crests and troughs as shown in FIG. **13** so that the body of the user experience the bending movements on the mattress. Therefore, the user can do slimming exercise on the mattress for health so that any excess fat can be removed from his or her body.

If the separation pieces **11** in the two serially-arranged separation piece groups, right and left, are moved by an electromagnetic clutch **31** with a swing phase of, for example, 90°, the right and left separation pieces **11** produce a bend phase shift in an up and down motion so that the user experiences right/left twisting motion on the mattress. The extent of twisting on the right and left separation pieces **11** is adjusted in a phase shift range of 0° to 180° where there is no twist for 0° and a maximum twist for 180°.

Since the right and left separation pieces **11** are bent in a phase shift fashion, the user experiences right/left twisting motions on the mattress while being bent at four places corresponding to the number of coupled areas of the separation pieces **11**. The user can get more effective slimming exercise than in the case where there is only one bend area.

FIGS. **14** and **16** show a fourth embodiment of the present invention. This embodiment is similar to the first embodiment, but is different from the latter embodiment in that a vibration generation device is provided in each of separation pieces. To put it more specifically, the respective separation piece **11** has a pair of rectangular openings **51** along its length. A rectangular vibration plate **52** is held in each opening **51** and is smaller than the opening **51**.

Frame members **51***a* and **52***a* are mounted on the inner wall surface of the opening **51** and outer peripheral surface of the vibration plate **52**. A pair of hooks **50** are projected from the corresponding portions of the respective frame members **51***a*, **52***a*. A coil spring **53** is stretched between the hooks of the opposed frames **51***a* and **52***a* so that each vibration plate **52** is so held as to be elastically displaceable in the opening **51**.

A vibrator **54** is mounted on the lower surface of each vibration plate **52** and comprises a casing **55**, motor **56** held within the casing **56** and weight **57** eccentrically rotated by the motor. These members **55**, **56** and **57**, together with the vibration plate **52**, constitute the vibration generation device as set out above.

The weight **57**, being eccentrically rotated by the motor **56**, produces vibration and hence the vibration plate **52** is moved in an up/down direction as indicated by arrows in FIG. **15**. With the vibration plate **52** vi-

brated in the up and down direction, corresponding vibration is transmitted to the user's body through a mattress **11** on a bedstead **13**, thus giving a massaging effect to the user.

The user side's operation section **137** in the fourth embodiment includes a power source switch **137***a*, first operation switch **137***b*, second operation switch **137***c* and speed control switch **137***d* as shown in FIG. **16**, noting that the first operation switch **137***b* is provided for controlling a current in an electromagnetic switch **31** and second operation switch **137***c* is provided for turning the vibrator ON and OFF.

According to the bed apparatus thus arranged, paired separation pieces **11**, right and left, in two arrays, upon being bent, impart motion to the user on the mattress as well as vibratory massage produced through the vibration of the vibration plate **52** by the vibrator **54**.

FIG. **17** shows a fifth embodiment of the present invention. The fifth embodiment is of such a type that, in the bed apparatus shown in the third embodiment, a pair of openings **51** are provided in a respective one of separation pieces **11** in a bedstead **13** as shown in the fourth embodiment with a vibration plate **52** elastically displaceably held in the corresponding opening **51** and a vibrator **52** is provided on the lower surface side of the vibration plate **52**.

FIGS. **18** and **19** show a sixth embodiment of the present invention. In the sixth embodiment, a drive shaft section **23***a* and driven shaft section **23***b* of a drive shaft **23** are connected together by a coupling **63**, not an electromagnetic clutch **31**. The coupler **63** comprises a first coupling disk **64** fixedly fitted over the end portion of the drive shaft section **23***a* and second coupling disk **65** fixedly fitted over the end portion of the driven section **23***b*.

A threaded shaft **66** is fixed to the first coupling disk **64** and projected as shown in FIG. **18**. The second coupling disk **65** has an elongated hole **67** which is circumferentially provided therein to an extent of substantially 180°. The threaded shaft **66** is inserted through the elongated hole **67** with a nut **68** fitted over the projecting end portion of the threaded shaft **66**. Due to the coupling disks **64** and **65** coupled together, the driven shaft section **23***b* can be moved in interlock with the rotation of the drive shaft section **23***a*.

The driven shaft section **23***b* is fixed to the drive shaft section **23***a* at a given rotation angle by making the second coupling disk **65** rotatable relative to the first coupling disk **64** with the nut **68** loosened, rotating the second coupling disk **65** to an extent that the elongated hole **67** allows the threaded shaft **66** to be slidably rotated therein and tightening the nut **68** to fix the first coupling disk **64** to the second coupling disk **65**.

Since, with the use of the coupler **63** as set out above, the rotation angle the driven shaft section **23***b* is made relative to the drive shaft section **23***a* can be arbitrarily set in a rotation angle phase of 0° to 180°, it is possible to arbitrarily set the swing phases of the separation pieces **11** in the bedstead **13** swingably driven by the drive shaft section **23***a* and separation pieces **11** in the bedstead swingably driven by the driven shaft section **23***b*.

FIGS. **20** and **21** show a seventh embodiment of the present invention. In this embodiment, a plurality (**12** in this embodiment) of separation pieces **11** are arranged widthwise in two arrays along a length of a bedframe **1**. The sixth separation pieces in each array are swingably mounted by a coupling member **8** on the upper end surface of a support member **7**.

The separation pieces **11** arranged in the two arrays as viewed in a width direction of the bedframe **1** are grouped into three groups G1, G2 and G3 in the longitudinal direction of the bedframe **1** as shown in FIG. **20** with two separation pieces **11** as each group.

The separation pieces **11** in each group are swingably driven by a corresponding separate drive mechanism such that their adjacent ends are coupled to a coupling tool **15** through a coupling member **14**. The coupling tool **15** is attached to the upper end surface of a movable arm **16**. A disk **19** is rotatably mounted on the movable arm **16** and eccentrically rotated by a drive shaft **23**.

The eccentric rotation of the disk **19** causes the movable arm **16** to be moved in up/down motion so that the paired separation pieces **11** in each group have their opposed ends moved in push/pull motion, e.g., in up/-down motion due to the presence of the coupling tool **15**. As a result, the paired separation pieces **11** are swingable, along the length of the bedframe **1**, about an area connected to the upper surface of the support member **7** through the coupling member **8**.

Three drive source sources **28** and electromagnetic clutches **31** in a drive mechanism for driving the separation pieces in each group are controlled by a controller **71**. The arranged separation pieces **11** in the respective groups G1, G2 and G3 have their swing phase set under control of the electromagnetic clutch **31**. The drive source **28** can be controlled by the controller **71** in a rotation speed of the drive shaft **23** and in a swing motion phase for each group of the separation pieces.

Thus the user can enjoy varying slimming exercise because the swing motion phase and speed can be controlled for each group of the separation pieces **11**.

FIGS. **22** to **25** show an eighth embodiment of the present invention. This embodiment can control a swing angle in the swing motion of the separation pieces **11**. FIG. **22** is a diagrammatic arrangement of the eighth embodiment where reference numeral **81** shows a bedframe. At the middle of width of the bedframe **81** a twin-shaft motor **82** is so arranged that a pair of drive shafts **83** extend along the width of the bedframe **81**, in a direction away from the motor.

A pair of rotation shafts **84**, **84** are connected at one end to the corresponding drive shafts **83** of the motor **82**. The other end of the respective rotation shaft **84** is rotatably journalled in a corresponding bearing **84***a*. The end of the respective rotation shaft **84** which extends out of a corresponding bearing **84***a* is integrally coupled by a key **86** to the center area of a rotation disk **85** as shown in FIG. **24**. An arcuate elongated hole **87** is provided in the rotation disk **85** as shown in FIGS. **23** and **25** and extends from one end A to the other end B in a gradually increasing distance from the center axis O of the rotation shaft **84** as shown in FIG. **25**, that is, a gradually increasing radius is defined from the end A to the end B of the elongated hole with the center axis O of the rotation shaft **84** as shown in FIG. **25**.

A bolt **88** is inserted from one side surface side of the rotation disk **85** and extends out of the other end surface side of the rotation disk **85** as shown in FIG. **24**. A stepped bush **89** is fitted over the portion of the bolt **88** extending out of the other surface side of the rotation disk **85**. An arm **91** has a mount hole **92** as its lower end portion and is rotatably inserted over the bush **89** via the mount hole **92**. A nut **93** is threaded, via a washer **94**, over the end portion of the bolt **88** extending out of the

bush **89**, thereby preventing the arm **91** from dropping off the bush **89**. With the nut **93** tightened the bolt **88** is fixed to the rotation disk **85** through the bush **89**.

As in the first embodiment, a long coupling tool **15** of the bedframe **81** is mounted on the upper end surface of the arm **91** and a pair of coupling members **14** are provided on the upper surface of the arm in a longitudinally spaced-apart relation. As in the case of the coupling member **14** in the first embodiment, the coupling member **14** is made of an elastic material and the ends of separation pieces **11** are connected to the corresponding coupling members **91**.

According to the eighth embodiment thus arranged, with the rotation disk **85** rotated, the arm **91** can be moved in up/down motion in accordance with an amount of eccentric movement corresponding to the fixed position of the bolt **88** in the arcuate elongated hole **87**. With the arm **91** moved in the up and down direction the corresponding pair of separation pieces **11** have their end portions moved in up/down motion, i.e., in a push/pull motion, due to the separation pieces **11** coupled to the upper end surface of the arm **91** by the coupling member **14**. It is, therefore, possible to swingably drive the ends of the separation pieces **11**.

The amount of eccentric movement of the arm **91** relative to the rotation disk **85** can be made variable by, with the nut **93** loosened, moving the bolt **88** along the elongated hole **87** in the rotation disk **85** and tightening the nut **93** in a given position so as to fix the bush **89** in place. The amount of eccentric movement (an up and down motion stroke) of the arm **91**, being varied, can vary the swing angle of the separation pieces **11** coupled to the arm **91**, that is, it is possible to set the swinging movement of the separation pieces **11** to a given proper extent.

The arm **91** is moved in an up and down motion due to the swinging movement of the rotation disk **85** and in rotation motion due to the aforementioned increasing radius extending relative to the center axis of the rotation disk **85** with the bolt **88** coupled thereto. However, the swinging movement is absorbed due to the bending of the coupling members **14** whereby the arm **91** is coupled to the corresponding separation pieces **11**, noting that the coupling member is made of elastic material. For this reason, no great stress is applied to the separation pieces **11** due to the rotation of the arm **91**.

FIG. **26** shows a ninth embodiment of the present invention. This is a modified structure where a vibrator **54** as shown in the fourth embodiment of FIGS. **14** to **16** is provided at the separation piece **11**. To be specific, with the ninth embodiment an elastic sheet **101** such as urethane foam is joined to the upper surface of the separation pieces **11**. A vibration transmitting plate **102** made of thin, relatively hard wood or synthetic resin is joined to the upper surface of the elastic sheet **101** and covered with a cover **103**.

A receiving hole **104** is provided in the elastic sheet **101**. The aforementioned vibrator **54** is mounted on the lower surface of the vibration transmitting plate **102** and dropped in the receiving hole **104**.

With the vibrator **54** operated the vibration transmitting plate **102** is vibrated while elastically deforming the elastic sheet **101**. As a result, a massaging effect can be imparted to the user on the mattress **12**. In this embodiment the user can enjoy slimming exercise over the covered elastic sheet without the use of a mattress **12**.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative devices, and illustrated examples shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. A bed apparatus comprising:

a bedframe;

a bedstead comprising a plurality of separation pieces that are divided in a longitudinal direction of the bedframe such that said separation pieces are arranged in two arrays in a width direction of the bedframe so that separation pieces of each array are adjacent to each other and are spaced apart from each other;

a plurality of coupling means for rotatably coupling adjacent end portions of a separation piece in each array to each other so that the two arrays are coupled to each other via said coupling means;

a drive shaft divided into a plurality of drive shaft sections coupled to drive one of said arrays of separation pieces and a plurality of driven shaft sections coupled to drive the other array of separation pieces such that said plurality of drive shaft sections and said plurality of driven shaft sections are rotatable in the width direction of the bed frame;

drive means for rotatably driving said plurality of drive shaft sections of said drive shaft;

power transmission means comprising:

a plurality of circular disks, each circular disk being mounted to be eccentrically rotatable on each of said plurality of drive shaft sections and each of said plurality of driven shaft sections; and

a plurality of movable arms respectively having first and second end portions, each movable arm having said first end portion thereof rotatably coupled to a respective one of said plurality of circular disks to enable each of said plurality of movable arms to be moved in an up and down direction by an eccentric rotation of said respective one of said plurality of circular disks, and said second end portion of each movable arm being coupled to a respective one of said plurality of coupling means coupling adjacent end portions of said separation pieces to each other; and

phase control means for coupling an end portion of each of said plurality of drive shaft sections to an end portion of a respective one of said plurality of driven shaft sections of the drive shaft and for setting a circumferential coupling angle between said plurality of drive shaft sections and said plurality of driven shaft sections to thereby selectively control a phase of a swinging motion of the separation pieces in one array that are driven by said plurality of drive shaft sections relative to said plurality of separation pieces in the other array that are driven by said plurality of driver shaft sections.

2. An apparatus according to claim **1**, wherein each separation piece has a longitudinal intermediate area, the longitudinal intermediate area of each separation piece being swingably attached by an elastic member to one of a plurality of support members, each support member being mounted on said bedframe to be in an upright, longitudinal direction of said support member.

3. The apparatus according to claim 1, wherein said power transmission means is settable by a user to set a length of a stroke in said up and down direction of each of said plurality of movable arms and wherein the up and down motion of each of said plurality of movable arms is transmitted to the bedstead.

4. The apparatus according to claim 1, wherein at least one of said plurality of separation pieces is coupled to a vibrator for producing vibrations.

5. The apparatus according to claim 4, wherein said vibrator is mounted on a lower surface side of a vibration transmitting plate that overlays said at least one of said plurality of separation pieces, and further comprising an elastic sheet provided between said at least one separation piece and said vibration transmitting plate.

6. The apparatus according to claim 5, wherein:

an opening is provided in said at least one separation piece;

said vibration transmitting plate is elastically displaceably mounted in said opening provided in said one separation piece; and

said vibrator is provided on a lower surface side of said vibration transmitting plate to vibrate said vibration transmitting plate.

7. An apparatus according to claim 1, wherein said phase control means includes means for controlling a swing phase of said separation pieces in each of said two arrays.

8. An apparatus according to claim 1, wherein said phase control means includes means for controlling a speed with which separation pieces in each of said two arrays are swung.

9. A bed apparatus comprising:

a bedframe;

a bedstead comprising a plurality of separation pieces that are divided in a longitudinal direction of the bedframe such that said separation pieces are arranged in two arrays in a width direction of the bedframe so that separation pieces of each array are adjacent to each other and are spaced apart from each other;

a plurality of coupling means for rotatably coupling adjacent end portions of a separation piece in each array to each other so that the two arrays are coupled to each other via said coupling means;

a drive shaft divided into a plurality of drive shaft sections coupled to drive one of said arrays of separation pieces and a plurality of driven shaft sections coupled to drive the other array of separation pieces such that said plurality of drive shaft sections and said plurality of driven shaft sections are rotatable in the width direction of the bed frame;

drive means for rotatably driving said plurality of drive shaft sections of said drive shaft;

power transmission means comprising:

a plurality of circular disks, each circular disk being mounted to be eccentrically rotatable on each of said plurality of drive shaft sections and each of said plurality of driven shaft sections; and

a plurality of movable arms respectively having first and second end portions, each movable arm having said first end portion thereof rotatably coupled to a respective one of said plurality of circular disks to enable each of said plurality of movable arms to be moved in an up and down direction by an eccentric rotation of said respective one of said plurality of circular disks, and said second end portion of each movable arm being coupled to a respective one of said plurality of coupling means coupling adjacent end portions of said separation pieces to each other; and

phase control means for coupling an end portion of each of said plurality of drive shaft sections to an end portion of a respective one of said plurality of driven shaft sections of the drive shaft and for setting a circumferential coupling angle between said plurality of drive shaft sections and said plurality of driven shaft sections to thereby selectively control a phase of a swinging motion of the separation pieces in one array that are driven by said plurality of drive shaft sections relative to said plurality of separation pieces in the other array that are driven by said plurality of driver shaft sections.

and wherein:

said phase control means comprises:

an electromagnetic clutch provided between said plurality of drive shaft sections and said plurality of driven shaft sections of said drive shaft to enable said plurality of drive shaft sections and said plurality of driven shaft sections to be coupled to and decoupled from each other;

a detector for detecting a rotation angle of said plurality of drive shaft sections and for providing a detection signal responsive to said detected rotation angle; and

control means for controlling a transmission to said electromagnetic clutch of said detection signal from said detector and for setting a rotation phase angle between said plurality of driven shaft sections and said plurality of drive shaft sections when said plurality of driven shaft sections are coupled to said plurality of drive shaft sections said the electromagnetic clutch; and

wherein the detector comprises:

a slip plate having a circumference, said slip plate including a plurality of throughbores provided at a given interval along a circumferential direction thereof, said slip plate being rotatable as one unit with one of said plurality of drive shaft sections; and

a sensor for detecting said throughbores in said slip plate.

10. An apparatus according to claim 9, wherein each of said separation pieces has a longitudinal intermediate area, said longitudinal intermediate area of each separation piece being swingably attached by an elastic member to one of a plurality of support members, each support member being mounted on said bedframe in an upright longitudinal direction of said support member.

11. The apparatus according to claim 9, wherein said power transmission means is settable by a user to set a length of a stroke in the up and down direction of each of said plurality of movable arms and wherein up and down stroke of each of said plurality of movable arms is transmitted to said bedstead.

12. The apparatus according to claim 9, wherein said control means comprises:

a coupler comprising:

a first coupling disk coupled to one of said plurality of drive shaft sections;

a second coupling disk coupled to one of said plurality of driven shaft sections; and

a coupling device for fixedly coupling said second coupling disk to said first coupling disk at a given angle.

13. The apparatus according to claim **9**, wherein at least one of said plurality of separation pieces is coupled to a vibrator for producing vibrations.

14. The apparatus according to claim **13**, wherein said vibrator is mounted on a lower surface side of a vibration transmitting plate that overlays said at least one of said plurality of separation plates, and further comprising:

an elastic sheet provided between said at least one separation piece and said vibration transmitting plate.

15. The apparatus according to claim **13**, wherein:

an opening is provided in said at least one separation piece;

said vibration plate is elastically displaceably mounted in said opening provided in said at least one separation piece; and

said vibrator is provided on a lower surface side of said vibration transmitting plate to vibrate said vibration transmitting plate.

16. An apparatus according to claim **9**, wherein said phase control means includes means for controlling a swing phase of separation pieces in each of said two arrays.

17. An apparatus according to claim **9**, wherein said phase control means includes means for controlling a speed with which separation pieces in each of said two arrays are swung.

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